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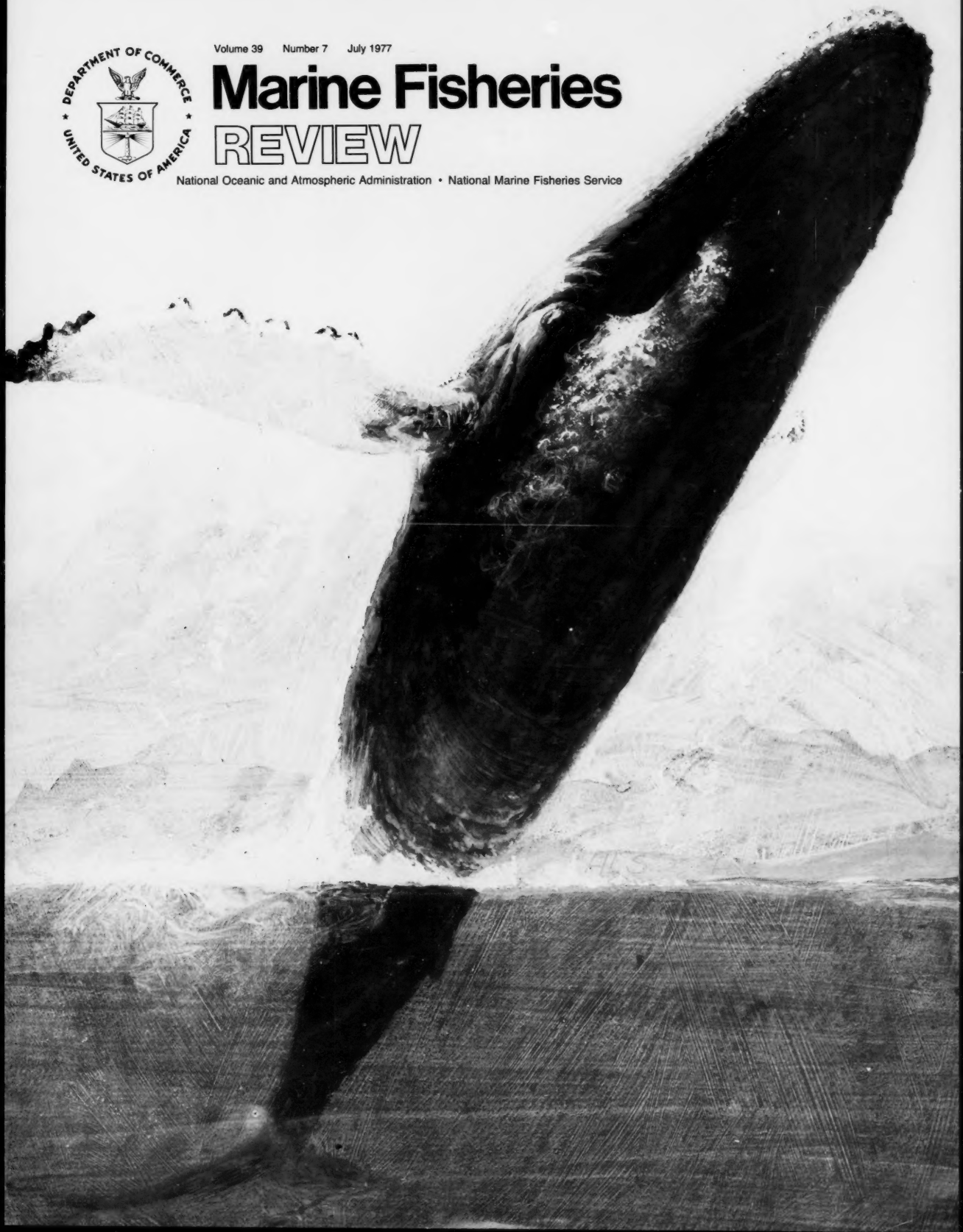
# Marine Fisheries REVIEW

National Oceanic and Atmospheric Administration • National Marine Fisheries Service



# Marine Fisheries Review

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Cover: A breaching humpback whale. For more on the species, see the article beginning on page 1.

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MFR PAPER 1254

# Humpback Whales in Hawaii: Vessel Census, 1976

ALLEN A. WOLMAN and CHARLES M. JURASZ

*ABSTRACT—Three hundred seventy-three humpback whales,* Megaptera novaengliae, *were seen around the main Hawaiian Islands during a vessel survey from 24 February to 6 March 1976. Indications are that this population represents a different stock from that summering in southeastern Alaska. No humpback whales were seen during a subsequent monk seal survey off the Leeward Islands.*

## INTRODUCTION

Humpback whales, *Megaptera novaeangliae,* wintering in Hawaiian waters, were surveyed by the Marine Mammal Division (MMD) of the National Marine Fisheries Service's (NMFS) Northwest and Alaska Fisheries Center in Seattle, Wash. The survey was undertaken from 24 February to 8 March 1976 to determine the distribution and abundance.

All humpback whale populations have become so diminished that the International Whaling Commission has prohibited their capture worldwide since 1966. The humpback whale has been on the U.S. Government's endangered species list since 1970.

Based on sighting surveys on the humpback's wintering grounds off Mexico (Rice, 1974) and its summering grounds from the Aleutians to the Chukchi Sea (Wada, 1975), it appears that there are no more than a few hundred animals east of long. 140°W. However, the entire North Pacific Ocean population numbers about 1,200 animals (Wada[1]; Gambell, 1976), and Wada (1975) indicated that sighting indices suggest that stock sizes are increasing. The worldwide population is estimated at about 5,200 (Federal Register, 1975) to 7,000 (Scheffer, 1976).

According to Nishiwaki (1966), there were formerly many humpbacks in eastern Aleutian and western Alaskan peninsula waters and six marked whales had moved from the east end of the Aleutian chain to the Ryukyu Island area. According to sightings by Berzin and Rovnin (1966), the largest number (75 percent) occurred during the summer from the eastern Aleutians to Unimak Strait. From 1925 to 1927, 3,037 humpback whales were caught in the North Pacific (Committee for Whaling Statistics, 1931). In 1962 and 1963, 3,115 humpbacks were taken in eastern Aleutian waters between lat 50° and 60°N and between long 150° and 170°W, according to catch statistics circulated by the North Pacific Working Group, Scientific Committee, International Whaling Commission.

In the eastern North Pacific Ocean, the humpback whale ranges from the Chukchi Sea south to southern California during the summer. Humpback whales are found as far south as Jalisco, Mexico, as well as near the Hawaiian Islands during the winter. The species is a tourist attraction in Hawaii and southeastern Alaska.

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[1]Wada, S. 1972. The ninth memorandum of stock assessment of whales in the North Pacific. Unpublished report of the Scientific Committee, International Whaling Commission, Red House, Station Road, Histon, Cambridge, CB 4 4NP, Engl.

## METHODS

### Vessel Census

The survey was conducted from the MV *Easy Rider* (Fig. 1), a 76-foot (23-m) aluminum fishing vessel with a cruising speed of 8.5 knots (16 km/h).

Figure 1.—Description of the MV *Easy Rider*.

**MV *Easy Rider***

Construction:
All aluminum, built in 1971.
Length, 76 feet; beam, 23.9 feet; draft, 4 to 3 feet.
Galley, four staterooms (2 beds and head in each).

Power:
Two V8-71 GMC diesel main engines.
Two 30 kw 240 V4 phase 2.71 GMC diesel generators.
One hydraulic crane, 2,400-pound capacity at 14½ feet reach.

Cruising speed:
Average 10 knots

Fuel capacity:
10,219 gallons

Range:
4,000 miles

Water capacity:
500 gallons plus evaporator making 20 gallons per hour when main engine is in use.

Cargo capacity:
30 tons of refrigerated or 35 tons dry

Electronics and Radio gear:
Sonar, radar, fathometer, loran, single side-band radio, AM marine radio, VHF radio automatic pilot.

Captain:
Gary Naftel

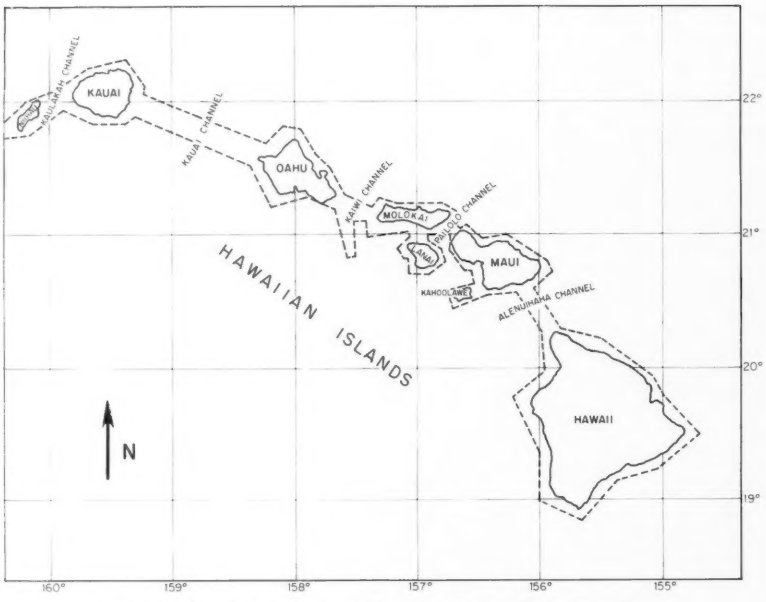


Figure 2.—Hawaiian Islands survey area; cruise track indicated by dashed lines.

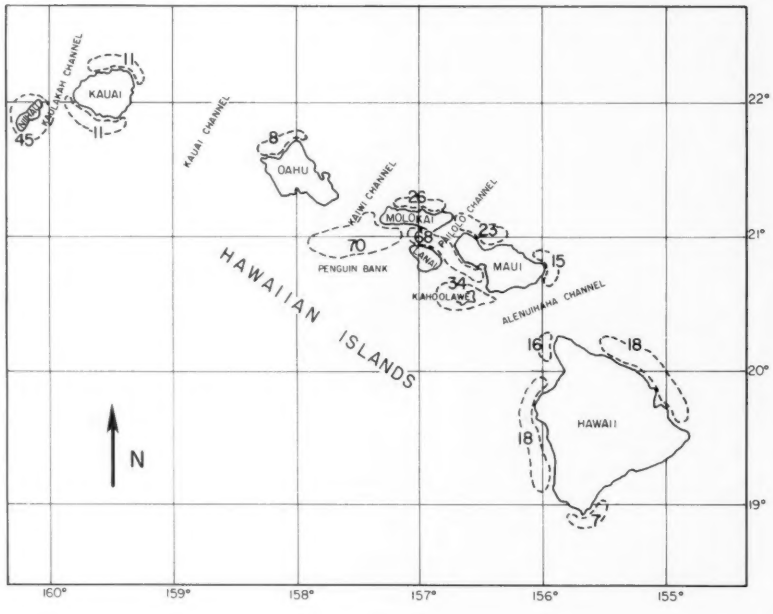


Figure 3.—Main concentrations of humpback whales seen during sighting cruise, 24 February to 6 March 1976.

The vessel circumnavigated all the main islands from Hawaii to Kauai and Niihau (Fig. 2). The cruise track closely followed the 50-fathom curve during the trip, except when crossing inter-island channels. The ship's bridge was 15 feet (4.6 m) above the waterline. The ship's course was not diverted to approach whales. Three observers generally spotted animals from the bridge. Prior to the vessel census, an aerial reconnaissance was made, during which it was found that many whales were distributed offshore over shallow banks between certain islands, such as Molokai, Maui, and Hawaii. The *Easy Rider* departed Honolulu, Oahu, on 24 February, cruised across Penguin Bank, and surveyed along the south and west sides of Molokai, Maui, and Hawaii. It then ran off the northern sides of Hawaii, Maui, Molokai, Oahu, and Kauai, circling Niihau and Kaula Rock, after which it returned to Honolulu along the southern edges of Kauai and Oahu on 6 March.

### Aerial Photography

On 8 March (1145-1545 hours), a Cessna 206 Skywagon[2] was used to photograph animals in an area of dense concentration found during the vessel survey. Portions of Penguin Bank, south of Molokai; Auau Channel, between Lanai and Maui; and the area between Lanai and Molokai were flown over, and Molokai was circled.

## RESULTS

### Distribution and Abundance

During the 12-day cruise (about 1,100 miles or 2,040 km), 373 humpback whales were observed (Table 1). Areas of greatest concentration were Penguin Bank, the islands of Niihau, Molokai, and Maui, the eastern side of Lanai, and the northern side of Kahoolawe (Fig. 3). No humpbacks were seen during a subsequent NMFS vessel survey for monk seals off the Leeward Islands, which was carried out from 17 March to 16 April aboard the *Easy Rider*.

During the 4-hour flying time, (about 440 miles or 815 km), 38 whales were observed and photographed.

Utilizing these data to estimate abundance in Hawaiian waters is problematical. Undoubtedly, we did not see all the whales and some may even have been counted twice due to our surveying one side of the island chain several

[2]Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

**Table 1.—Number and location of humpback whales observed during vessel survey, 24 February to 6 March 1976.**

| Date | No. of whales seen | Position | | | |
|---|---|---|---|---|---|
| | | Beginning | | Ending | |
| | | *Lat. N* | *Long. W* | *Lat. N* | *Long. W* |
| Feb. | | | | | |
| 24 | 71 | 21°18′ | 157°52′ | 20°53′ | 157°04′ |
| 25 | 68 | 20°53′ | 157°04′ | 20°38′ | 156°30′ |
| 26 | 50 | 20°38′ | 156°30′ | 20°03′ | 155°51′ |
| 27 | 18 | 20°03′ | 155°51′ | 18°57′ | 155°43′ |
| 28 | 14 | 18°57′ | 155°43′ | 19°45′ | 155°05′ |
| 29 | 19 | 19°45′ | 155°05′ | 20°45′ | 155°59′ |
| Mar. | | | | | |
| 1 | 52 | 20°45′ | 155°59′ | 21°07′ | 157°19′ |
| 2 | 8 | 21°07′ | 157°19′ | 21°33′ | 158°16′ |
| 3 | 11 | 21°33′ | 158°16′ | 22°12′ | 159°31′ |
| 4 | 25 | 22°12′ | 159°31′ | 21°47′ | 160°13′ |
| 5 | 36 | 21°47′ | 160°13′ | 21°57′ | 159°51′ |
| 6 | 1 | 21°57′ | 159°51′ | 21°18′ | 157°51′ |

days after surveying the first side. This latter source of error may have been minor, though, since similar areas of concentration were found before the vessel survey and few whales were found moving between islands. If the two sources of error were equivalent, then it might be concluded that at least 373 whales are wintering in Hawaiian waters.

Of the 373 humpbacks seen, only 7 were in deep inter-island channels or in water deeper than 300 feet (92 m). The humpbacks were found most frequently in close proximity to islands, in waters 330 feet (100 m) or less in depth, and in the 100-m deep underwater peninsula extending offshore southwest of Molokai, Penguin Banks. More whales were noted on the lee than the windward side of the islands. Areas of concentration noted in early February by Jurasz during precensus flights yielded numbers of the same magnitude in early March.

## Group Size and Behavior

Of 373 whales counted by ship, 281 (75.3 percent) occurred singly or in pairs (Table 2). Groups larger than five animals were not seen.

**Table 2.—Number and group size of humpback whales surveyed by ship and aircraft, 24 February to 8 March 1976.**

| Survey vehicles | Group Size | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Ship | 137 | 144 | 48 | 24 | 20 |
| Aircraft | 6 | 10 | 9 | 8 | 5 |

Figure 4.—Full body breach by humpback whale.

Feeding was not seen, although defecation (a whitish cloud) was observed once during the vessel survey and twice during the aircraft flight, indicating that at least some feeding must have occurred.

When aircraft were employed for reconnaissance or censusing, groups of whales could be observed forming larger loose aggregations. Some pairs consisted of an adult and a calf and others, of two adults. The most dynamic surface activity observed was full body breaching (Fig. 4) and occasional "finning" or striking the water's surface with the flippers or pectoral fin.

Interaction between species was observed on 26 February. Three adult humpbacks were sighted in loose association approximately 2 miles offshore at Honoipu off the northern end of the island of Hawaii. The weather was strongly overcast with rain falling near the animals. We were first attracted by a large splash that looked like a breach. As the vessel approached, it became apparent that the splashing was caused by an adult raking its flukes laterally across the water. Another adult was less than 10 feet (3 m) away and lying parallel to the first. From a distance of 1 mile (1.6 km), we observed that the two adults operated as a pair and were surrounded by about 100 pygmy killer whales that were milling in an apparently random pattern.

When one of the pair of humpbacks dove, a pair of dolphins dove synchronously less than 6 feet (2 m) away from the corners of the humpback's mouth, one on either side. When the companion dove, a pair of dolphins also dove on either side of it just forward of the dorsal fin. During this attendance, five dolphins lay at rest in echelon at the surface, while others swam as isolated animals in random directions, apparently taking random breaths. When the

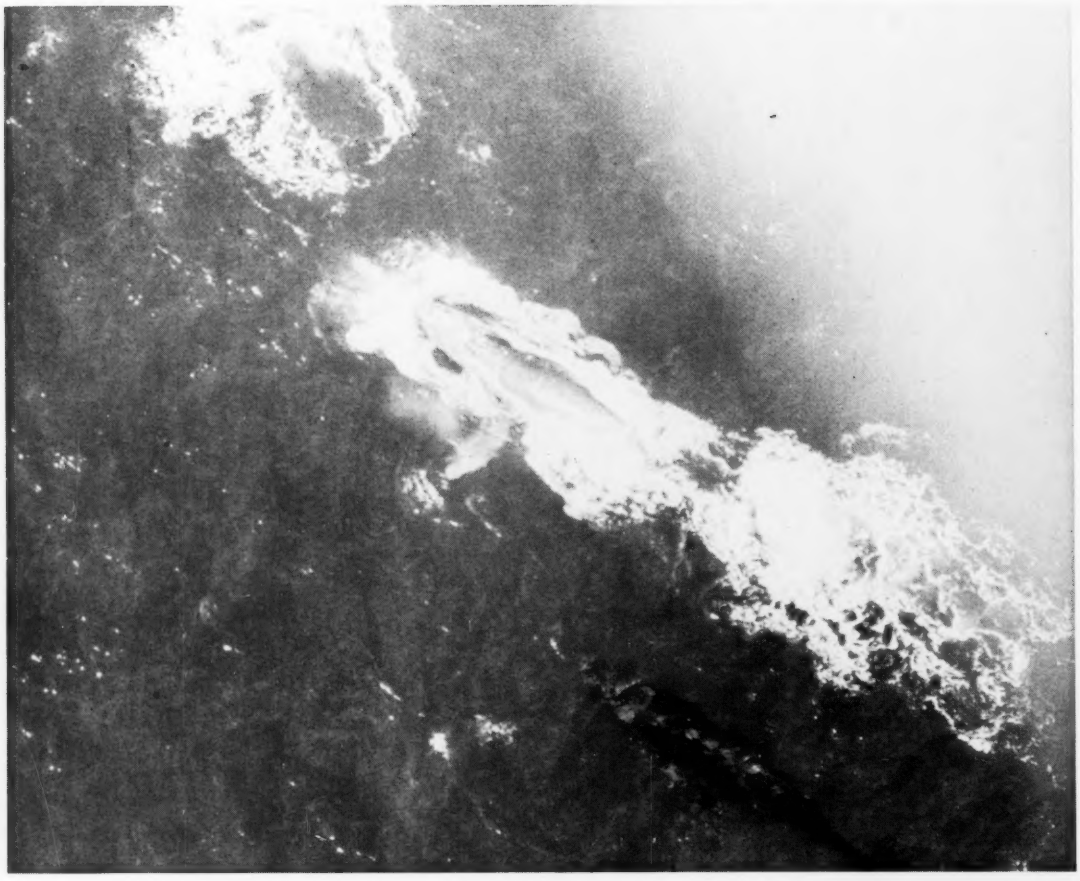

Figure 5.—Aerial view of humpback whales underwater. Note both animals with white dorsally on flippers and animals with black.

pair of humpbacks moved, the dolphins also moved—not initiating direction but quickly responding to it. On several occasions the dolphins were observed and photographed in a "mock" breaching position, i.e., in a pattern mimicking a humpback's half-body breaching, exposing the body vertically half out of the water and falling onto the dorsal side. These activities lasted while we watched for about 20 minutes and continued as we left.

### Color Phases

Lack of white dorsal surfaces on humpback whale flippers can be used to identify certain populations. Of the animals seen during the census, over one-third had all or mostly white dorsal "flipper" surfaces that were highly visible (Fig. 5). Humpback whales that summer in southeastern Alaska have white coloration only on a small portion of the dorsal surface of the pectoral appendages; this group, therefore, was not from southeastern Alaska. It is not known where Hawaiian animals spend the summer.

### Interference With Whales

Interference with the normal activities of whales appears to be a growing problem in Hawaii. During the month prior to the vessel census, five organizations or individuals were operating or scheduled to begin operations from Maui, using vessels to record and photograph the humpback whales at close quarters. During the census small high-speed craft were observed racing through areas with cows and calves. One instance of apparent deliberate interference was recorded and reported to NMFS enforcement personnel. Interference with these whales appears to be increasing and may soon be as prevalent as that involving gray whales off San Diego, Calif. (Carl L. Hubbs, pers. commun.).

### Other Cetaceans

Other cetaceans sighted on the cruise included *Steno bredanensis, Stenella attenuata, Stenella longirostris, Pseudorca crassidens, Feresa attenuata, Tursiops truncatus, Stenella*

Table 3.—Cetacean species, other than humpback whales, observed during vessel census, 24 February to 6 March 1976.

| Date | Time | Species | No. | Position | |
|---|---|---|---|---|---|
| | | | | Lat. N | Long. W |
| Feb. | | | | | |
| 25 | 0725 | *Steno bredanensis* | 8 | 20°53′ | 157°03′ |
| 25 | 0820 | *Stenella attenuata* | 50± | 20°45′ | 157°00′ |
| 26 | 1605 | *Feresa attenuata* | 100± | 20°15′ | 155°55′ |
| 26 | 1720 | *Stenella attenuata* | 6 | 20°06′ | 155°55′ |
| 27 | 1230 | *Stenella attenuata* | 8 | 19°30′ | 155°58′ |
| 28 | 0715 | Unident. porpoise | 30± | 18°57′ | 155°43′ |
| 28 | 0909 | *Stenella attenuata* | 2 | 19°00′ | 155°35′ |
| 28 | 1620 | *Steno bredanensis* | 3 | 19°39′ | 154°57′ |
| 29 | 1245 | *Stenella longirostris* | 30± | 20°25′ | 155°44′ |
| 29 | 1502 | Unident. porpoise | 4 | 20°32′ | 156°02′ |
| 29 | 1555 | *Pseudorca crassidens* | 1 | 20°38′ | 156°06′ |
| 29 | 1645 | *Stenella attenuata* | 5 | 20°42′ | 156°00′ |
| Mar. | | | | | |
| 1 | 1040 | *Tursiops truncatus* | 5 | 20°59′ | 156°28′ |
| 1 | 1540 | *Stenella attenuata* | 10 | 21°13′ | 156°58′ |
| 2 | 0855 | *Steno bredanensis* | 3 | 21°15′ | 157°21′ |
| 2 | 1420 | *Stenella attenuata* | 6 | 21°44′ | 157°56′ |
| 2 | 1545 | *Stenella attenuata* | 4 | 21°38′ | 158°08′ |
| 3 | 0805 | Unident. porpoise | 1 | 21°36′ | 158°24′ |
| 4 | 0715 | *Tursiops truncatus* | 3 | 22°12′ | 159°31′ |
| 4 | 1107 | *Stenella attenuata* | 20 | 22°03′ | 160°06′ |
| 4 | 1155 | Unident. whale | 1 | 22°00′ | 160°13′ |
| 4 | 1610 | *Stenella coeruleoalba* | 5 | 21°39′ | 160°32′ |
| 6 | 1420 | *Kogia breviceps* | 4 | 21°30′ | 158°18′ |
| 6 | 1450 | *Stenella attenuata* | 1 | 21°28′ | 158°14′ |

*coeruleoalba*, and *Kogia breviceps* (Table 3).

## DISCUSSION

The humpback whales of Hawaii are an important tourist attraction. They are regularly seen from cruise ships and interisland hydrofoils that ply these waters. This is one of the few places in the world where the general public has an opportunity to observe the great whales in their natural habitat.

A possibility exists that because the Hawaiian hydrofoil ferry lanes pass through certain areas of high whale concentration, collisions will occur that may result in whale deaths, vessel damage, and human injury. The vessels were rerouted in 1975 during the time of year that the animals were in abundance to avoid the more densely concentrated areas. A number of researchers in Hawaii (Edward Shallenberger, pers. commun.) are working on the extent of the problem.

Meanwhile, the MMD plans to continue surveys of Hawaiian waters to improve existing knowledge of humpback whale distribution and abundance. Future plans include surveys in waters off Mexico and the Aleutian Islands east to Prince William Sound and southeastern Alaska. Work is now proceeding on a radio-tracking pilot study in southeastern Alaska with possible extensions to other areas as a means of determining migrations to wintering grounds.

## ACKNOWLEDGMENTS

We wish to thank Edwin K. W. Lee and Richard S. Shomura of the National Marine Fisheries Service, Honolulu Laboratory, for assistance in acquiring a survey vessel as well as Tim D. Smith of the University of Hawaii and Edward Shallenberger of Sea Life Park for valuable presurvey suggestions and information concerning habits of the local whale stock.

The survey was discussed with William F. Takata, Hawaiian Division of Fish and Game, and Robert T. B. Iversen, Regional Representative, Southwest Regional Office, NMFS.

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MFR PAPER 1255

# Use of Salt (NaCl) Water to Reduce Mortality of Chinook Salmon Smolts, *Oncorhynchus tshawytscha*, During Handling and Hauling

CLIFFORD W. LONG, JERRY R. McCOMAS, and BRUCE H. MONK

*ABSTRACT—A major research program on the Columbia and Snake Rivers is designed to increase survival of juvenile salmon and trout by capturing them at an upriver dam, transporting them around a series of dams, and releasing them into the Columbia River. Excellent results have been obtained with steelhead trout,* Salmo gairdneri. *However, the mortality of chinook salmon,* Oncorhynchus tshawytscha, *immediately following their transportation has adversely affected the percentage that return as adults.*

*In a small-scale study conducted in 1975 at Bonneville Dam, adding salt (NaCl) to the water during handling and hauling increased the survival of juvenile chinook salmon and protected test fish against* Saprolegnia *spp., a fungus that infected several of the control fish. The addition of salt to the water in future transportation studies should reduce delayed mortality of juvenile chinook salmon and thereby increase the percentage that return as adults.*

## INTRODUCTION

Reducing the mortality of juvenile chinook salmon, *Oncorhynchus tshawytscha*, during handling and hauling by truck tanker is becoming increasingly important to the success of a major research program on the Columbia and Snake Rivers. This research, a cooperative study by the National Marine Fisheries Service (NMFS) and the U.S. Army Corps of Engineers, is aimed at reducing the loss of migrating (smolting) juvenile chinook salmon and steelhead trout, *Salmo gairdneri*, that must pass through eight dams before reaching the Pacific Ocean. The program involves collecting the downstream migrants at an upstream dam, transporting the fish around the remaining dams, and releasing them back into the river (Trefethen and Ebel, 1973). This method averts the major problems associated with passage at and between dams, such as passage through river water supersaturated with atmospheric gases, passage through turbines, predation, and excessive delay of the migrating fish.

Survival of both transported steelhead trout and chinook salmon in terms of returning adults has been dramatically increased, compared with nontransported controls. However, the survival of transported steelhead trout has been consistently higher than that of transported chinook salmon. One reason for this difference is the excessive delayed mortality of chinook salmon smolts occurring immediately after truck transport. Decrease of the mortality associated with handling and hauling may increase the percentage of chinook salmon smolts that return as adults to levels approximating those of steelhead trout.

Disease and stress were suspected as causing the excessive delayed mortality among chinook salmon smolts. Diseases have been identified in both steelhead trout and chinook salmon stocks being transported. These conditions led to studies for developing effective countermeasures. To minimize stress on the fish, NMFS researchers streamlined the methods of handling the fish and made several improvements in the truck transport design. In spite of these improvements, excessive delayed mortality of chinook salmon continued in some loads. Researchers then examined the possible use of salt water to reduce mortality of salmon and trout during handling and hauling by tank trucks.

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## LITERATURE SEARCHED FOR INFORMATION ON USE OF SALT WATER

Available evidence implies that stress due to handling and hauling can be alleviated by adding NaCl to the water containing the fish. Sykes (1950) and later Chittenden (1971) showed that transporting American shad fingerlings, *Alosa sapidissima*, in seawater diluted to salt concentrations of about 5 parts per thousand (ppt) increased their survival. Wedemeyer (1972) showed that with both coho salmon, *O. kisutch*, and steelhead trout fingerlings, stress due to handling — as measured by blood chemistry changes—was alleviated by the addition of 3 ppt NaCl to the water prior to handling the fish. Collins and Hulsey (1963) reported that hauling loss of threadfin shad, *Dorosoma petenense*, was reduced from 50 percent to 5 percent by transporting the fish in a combination of 5 ppt NaCl and an anesthetic (MS222). Similar benefits were reported by Hattingh et al. (1974) for a variety of freshwater fish found in Africa. Although the Washington (State) Department of Fisheries has been transporting chinook salmon smolts in salt water, no data have been generated to quantify benefits[1].

Besides alleviating the effects of stress, salt water has therapeutic value

[1]J. W. Woods, Washington Department of Fisheries, M-5 Fisheries Center, Univ. Wash., Seattle, WA 98195, pers. commun.

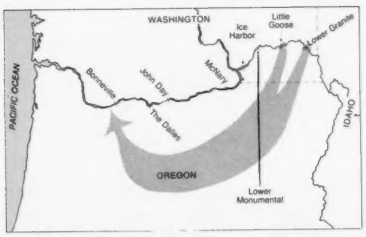


Figure 1.—Ongoing fish-transportation studies involve collecting seagoing juvenile salmonids at upstream dams, hauling the fish by truck around a series of dams, and releasing the fish into the Columbia River to continue their migration to the Pacific Ocean.

and can prevent the transmission of freshwater diseases from one fish to another. Davis (1953) reported that salt water constitutes an effective treatment for certain noxious protozoa and fungi. The transmission of *Flexibacter columnaris*, the freshwater bacterium that causes columnaris disease, is prevented in water containing 8.5 ppt salt[2].

It was clear from the literature that salt water provides benefits in handling and hauling operations, but the degree to which survival of chinook salmon smolts could be increased remained a matter of speculation.

## FISH TRANSPORTATION SYSTEM ON THE SNAKE AND COLUMBIA RIVERS

The salt studies conducted in 1975 and reported here were designed within constraints dictated by the ongoing fish-transportation program. In general, the fish to be transported are diverted out of turbine intakes at Little Goose and Lower Granite Dams on the Snake River with submersible traveling screens and into fish bypasses that transport the fish around the dams (Smith and Farr, 1975). The fish are removed from the bypass, anesthetized, and marked (by removing the adipose fin, by "branding," and by insertion of a magnetized wire into the cartilage of the nose); they are then placed in transport trucks (Ebel et al., 1973; Smith and Ebel, 1973). The trucks haul the fish to a point downstream from Bonneville Dam (Fig. 1), a trip of 8-10 hours, where they are released into the Columbia River to continue their migration to the Pacific Ocean.

To estimate mortality that may occur after the fish are released, a sample is removed from the truck and kept for 48 hours in holding tanks at Bonneville Dam. For 1971 through 1975, results of these delayed mortality studies have indicated that 15 to 20 percent of the chinook salmon die within 48 hours after release from the truck, but steelhead trout smolts incur less than 1 percent mortality.

## SALT USED IN EXPLORATORY STUDIES

Attempts to increase the survival of transported chinook salmon smolts by adding salt (NaCl) to the water were conducted at Bonneville Dam where studies on delayed mortality of transported fish were underway (Figs. 2-4). Three experiments were conducted. In the first two experiments, we obtained samples of fish from the regular transport trucks carrying fish to Bonneville Dam in fresh water. In the third experiment, in addition to the standard freshwater loads, three loads were hauled from Little Goose Dam in salt water.

In the first experiment, groups of 25 fish were placed in fresh water and in salinities of 1, 3, and 5 ppt. All groups received a 10-count stress (Fig. 5) every 2 hours for the first 12 hours of the test period. This four-group comparison was replicated four times.

In the second experiment, groups of 25 fish were placed in fresh water and in salinities of 5, 10, and 15-20 ppt. This four-group comparison was replicated three times—however, the first replicate received a 10-count stress; the second, a 15-count stress; and the third, a 20-count stress every 2 hours for the first 8 hours of the test period.

In the third experiment, groups of 25 fish hauled in salt water (5 ppt) or fresh


Figure 2.—Technicians removing a sample of chinook salmon smolts from 5,000-gallon fish-transport truck.

Figure 3.—NMFS personnel preparing a brine solution.

Figure 4.—Scientist measuring salt concentrations of water sample removed from fish-transport truck.

[2]P. M. Fujihara, Battelle Northwest, Richland, Wash., pers. commun.

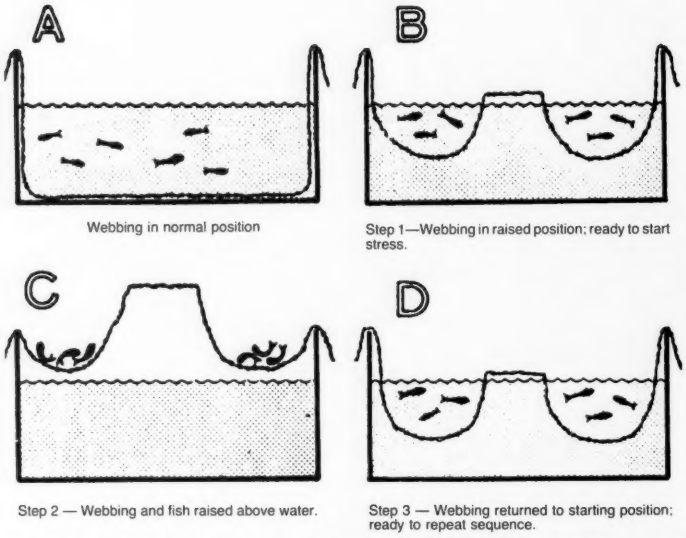


Figure 5.—Procedure for imposing a controlled stress on fish in test tanks. Raising the webbing and fish out of the water 10 times (steps 1, 2, and 3 repeated 10 times at the rate of once per second) is referred to as a 10-count stress.

water were placed in test tanks for 72-114 hours. Half of the test tanks were filled with fresh water and the other half with salt water at a salinity of 5 ppt. A 10-count stress every 2 hours for the first 16 to 24 hours of the holding period was imposed on half of the groups of fish in both the fresh and salt water.

## SALTWATER MEDIUM BENEFICIAL

The results of the first experiment are shown in Figure 6 which compares the survival, over a 24-hour period, of four groups of transported chinook salmon smolts subsequently held in either fresh water or salt water at salinities of 1, 3, or 5 ppt. Survival of fish in all salinities tested was significantly higher than survival in fresh water. The data imply, however, that a salinity of 1 ppt was not as beneficial as salinities of 3 and 5 ppt. A chi-square test failed to demonstrate that this difference in survival was significant at the 90 percent level of confidence. Additional tests using larger numbers of fish would be necessary to determine whether this difference in survival is significant.

Figure 7 shows the results of the second experiment by comparing the survival, over a 24-hour period, of transported chinook salmon smolts subsequently held in either fresh water or salt water at salinities of 5, 10, or 15 to 20 ppt. Survival of fish in all salinities tested and for all levels of stress was nearly 100 percent; only one mortality occurred in 225 fish tested. On the other hand, survival of fish in fresh water was only 80 percent for the 10-count stress and decreased to 16 percent for the 20-count stress.

Figure 8 portrays the average survival under different conditions, of chinook salmon smolts taken from each of three truckloads of fish hauled in salt water and three truckloads of fish hauled in fresh water (third experiment). As in the previous two experiments, the addition of salt had definite benefits. Fish hauled and held in salt water had a survival of 98.2 percent whether they received the controlled stress or not. Fish hauled in salt water and held in fresh water without stress had a survival of 97.3 percent—not significantly different from those groups hauled in salt water and held in salt water. Of the fish hauled in salt water and held in fresh water, the stressed groups had a significantly lower survival (93.3 percent) than the unstressed groups (97.3 percent). Being

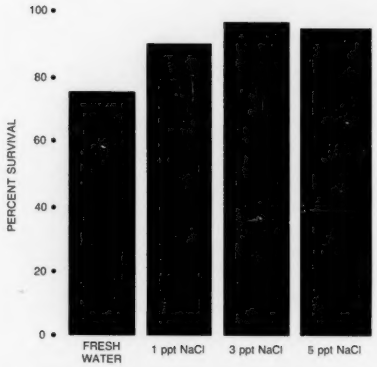


Figure 6.—Results of a 24-hour experiment comparing survival of chinook salmon smolts held in fresh or salt water. All groups were given a 10-count stress every 2 hours for the first 12 hours.

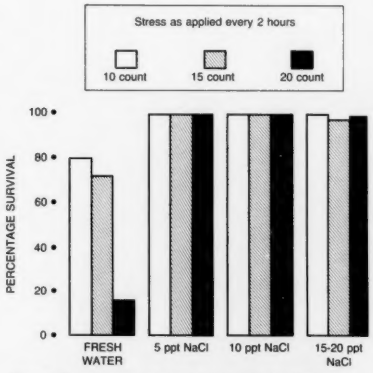


Figure 7.—Results of a 24-hour experiment showing increased survival of chinook salmon smolts held in salt water by comparison with fish held in fresh water. Stress was applied at the level indicated every 2 hours for the initial 8 hours.

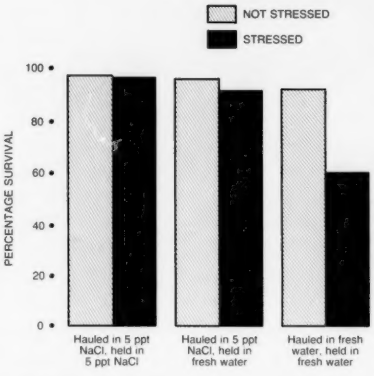


Figure 8.—Survival of chinook salmon smolts hauled in 5 ppt salt water or fresh water when held and stressed in salt water or fresh water. All stressed groups were given a 10-count stress every 2 hours for the first 16-24 hours.

hauled in salt water, however, obviously benefited the fish even after they were placed in fresh water; their counterpart (stressed) group hauled in fresh water had a survival of only 60.5 percent.

Our tests also provided evidence of the value of salt in disease prevention. Figure 9 portrays graphically the time of occurrence of mortality during the third and final test for those groups of test and control fish that received the controlled stress. Note that the initial occurrence of high mortality for fish hauled and held in fresh water was associated with the period during which stress was imposed. When the stress treatment was stopped, mortality lessened. The sudden increase in mortality at about hour 80 was due primarily to *Saprolegnia*, a fungus which commonly infects weakened fish. On the other hand, fish that had been transported in 5 ppt salt water were free of this disease whether they were being held in fresh or salt water.

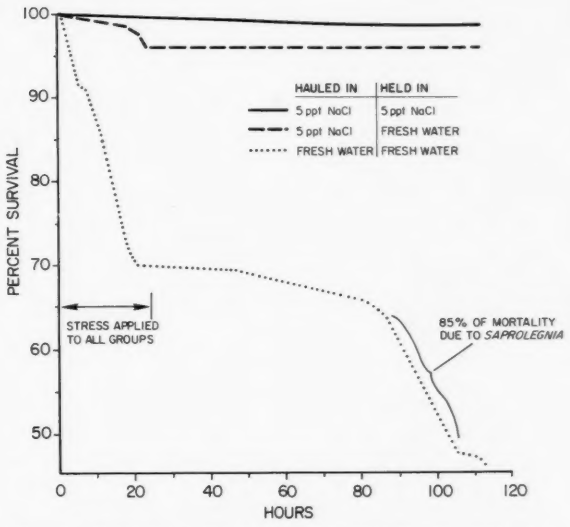


Figure 9.—Cumulative survival of groups of fish while held and stressed in salt or fresh water after having been hauled in either salt or fresh water. Fish hauled in salt water had increased resistance to stress and the disease *Saprolegnia* by comparison with fish hauled in fresh water.

## IMPLICATIONS OF SALTWATER USE

These studies show clearly that adding salt (NaCl) to water dramatically increases the survival of yearling chinook salmon smolts subjected to stressful conditions caused by handling and hauling.

We believe that the benefits to be gained by using salt water during the transportation program will be even greater than indicated by these limited studies—the test fish we used were the survivors of fish that had already undergone the stresses of the handling system at Little Goose or Lower Granite Dams. The addition of salt to the water used to hold, anesthetize, and mark the fish before hauling should yield additional benefits.

Additional studies will determine the concentration of salt that will yield optimum benefits for both the stress and disease problems. In this study, a salinity of 15 ppt was not too high for successfully mitigating the effects of stress, and *Saprolegnia* was successfully controlled using only 5 ppt salt. Higher salinity levels may yield more rapid and effective benefits against disease.

We see no serious constraints to implementing large-scale use of salt in the handling and hauling studies to be conducted in the future on the Snake and Columbia Rivers. Benefits could be determined by using salt on only a portion of the smolts for the first 1 or 2 years and comparing the percentage of individuals of each group that return as adults 1 to 3 years later.

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MFR PAPER 1256

# Improved Bypass and Collection System for Protection of Juvenile Salmon and Steelhead Trout at Lower Granite Dam

GENE M. MATTHEWS, GEORGE A. SWAN, and JIM ROSS SMITH

*ABSTRACT—A new and improved system for diverting, bypassing, and collecting juvenile salmon,* Oncorhynchus *sp., and steelhead trout,* Salmo Gairdneri, *at Lower Granite Dam on the lower Snake River is described. Major changes from previous systems of this type include a special fish screen slot for placement of the improved traveling screen, an open gallery bypass system for routing fish around the turbines, and a collection and holding area totally supplied by gravity-flow. The system is currently being evaluated by the National Marine Fisheries Service under contract to the U.S. Army Corps of Engineers.*

## INTRODUCTION

The National Marine Fisheries Service is conducting research on improving survival of juvenile Pacific salmon, genus *Oncorhynchus*, and steelhead trout, *Salmo gairdneri*, during their downstream migration. A major portion of the research emphasizes the development of safe diversion, bypass, and collection systems at dams on the Columbia and Snake Rivers in the Pacific Northwest (Fig. 1). Smith and Farr (1975) described a bypass and collection system for Little Goose Dam on the Snake River that utilized traveling screens in turbine intakes, submerged orifices in turbine intake gatewells, and an enclosed fish-transport pipe between the gatewells and the holding facility. This system was evaluated from 1971 through 1973, and the improvements were incorporated into the design of a similar facility at Lower Granite Dam (recently constructed 30 miles upstream from Little Goose Dam). This report describes further improvements and modifications, designed to provide safer and more efficient handling and movement of fish, at the Lower Granite Dam facility.

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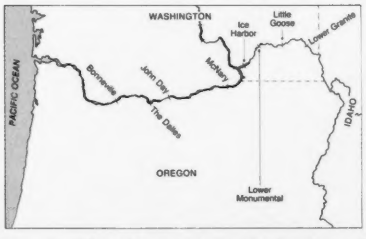



Figure 1.—Map of area showing the locations of dams on the lower Columbia and Snake Rivers.

## FACILITIES AND IMPROVEMENTS

### Fish Screening Facilities

The turbine intakes and gatewells of Lower Granite Dam are basically identical to those of Little Goose Dam with one major exception. At Lower Granite Dam an additional slot, the special fish screen slot, was constructed upstream from each intake bulkhead slot—specifically for the placement of a traveling screen (Fig. 2). The fish screen slot differs from the bulkhead slot in the following features:

1) The fish slot is closer to the entrance of the turbine intake where the cross-sectional area is larger and the approach velocity is less.

2) The angle of flow passing the fish screen slot is more acute because the intake ceiling is steeper at this point.

3) The fish screen slot is isolated from other gate slots and considerably narrower (from front to back). Therefore, no vertical barrier screen is required to confine fingerlings.

4) A small screened opening (10 feet by 20 feet) is located approximately 15 feet below the water surface on the downstream wall of the slot. Upwelling flows caused by a traveling screen in the fish screen slot are discharged through this screened opening and pass downward through three vertical shafts (approximately 3 feet in diameter), referred to as the Wagner horn (Fig. 2), and back into the turbine intake.

5) The ceiling of the turbine intake on the upstream side of the fish screen slot is cut off horizontally, creating a larger opening into the fish screen slot than into the bulkhead slot when a traveling screen is installed.

Standard traveling screens, such as those used at Little Goose Dam and described by Farr (1974) and by Smith and Farr (1975), are used at Lower Granite Dam without modification and operate satisfactorily in the bulkhead slot but not in the fish screen slot. When tested in the fish screen slot, descaling and injury of fingerlings increased while guiding efficiency decreased. The angle of the traveling screen in relation to the water flow in the intake was determined to be the main cause of the problem. The standard traveling screens operate at a fixed 45° angle from vertical, which results in the

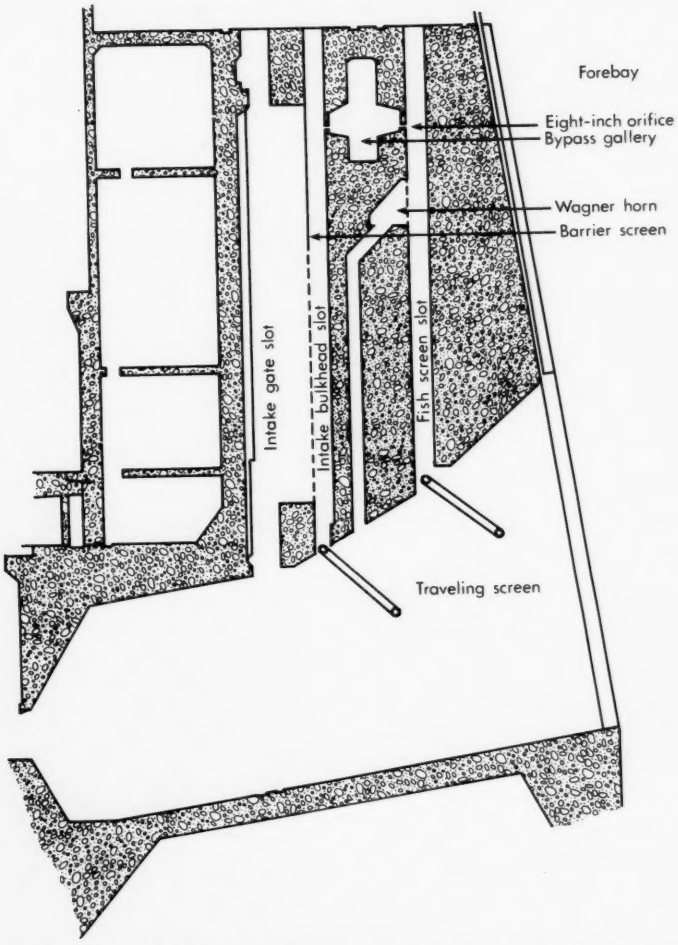



Figure 2.—Cross sectional view of turbine intake at Lower Granite Dam indicating principal features of the bypass system. Note that traveling screen is shown in the bulkhead slot but it can be placed in the fish screen slot.

Figure 3.—New, adjustable angle, traveling screen currently being tested at Lower Granite Dam.

screen being nearly perpendicular to the water flow when placed in the fish screen slot. The angle of the screen needed to be increased from 45° to an angle more closely approximating the angle to flow achieved in the bulkhead slot.

As a result of the deficiencies of the standard traveling screen, an experimental traveling screen (Fig. 3) is being developed by the U.S. Army Corps of Engineers for use in either the fish screen slot or the bulkhead slot. The unit is undergoing extensive testing by NMFS. The most prominent feature of the new screen is an adjustable angle of extension which can be adjusted in 5° increments from 45° to 65°. Other features include the following:

1) It has two rotating woven monofilament mesh belts instead of four rotating wire mesh belts.

2) The new traveling screen does not require a bottom support structure as was used with some of the earlier standard screens. It is lowered by gantry crane to the operating level where it hangs in the turbine intake with the top of the support structure wedged in the narrowing lower area of the bulkhead or fish screen slots. The picking beam is disconnected and retrieved, eliminating the need for pendant support cables in the gatewells while the traveling screen is down and operating.

3) The hydraulic power unit for driving the screen belt is watertight and located on the upper truss of the support structure, whereas the hydraulic power units for the standard traveling screens are located on the intake deck and connected to the traveling screen by about 90 feet of high-pressure hose.

### Gatewell Orifices and Bypass System

Fingerlings diverted from the turbine intakes to either the bulkhead slot or the fish screen slot enter the bypass gallery by passing through one of two 8-inch illuminated orifices, about 6 feet below the water surface near the appropriate corners of the respective slots (Fig. 4). Orifices from the bulkhead slots empty into the gallery opposite those from the

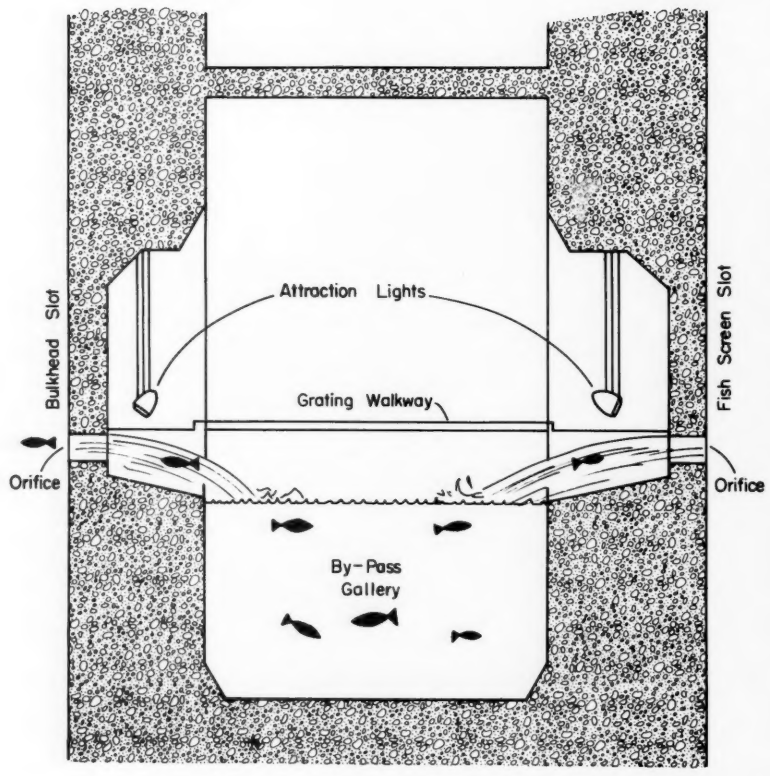



Figure 4.—Cross section of fingerling bypass gallery, showing orifices that pass fingerlings from bulkhead and fish screen slots.

fish screen slots. The opposing orifices are slightly staggered to prevent the two streams of water from contacting one another. A slide gate is installed on the gallery side of each orifice to allow them to be opened or closed quickly.

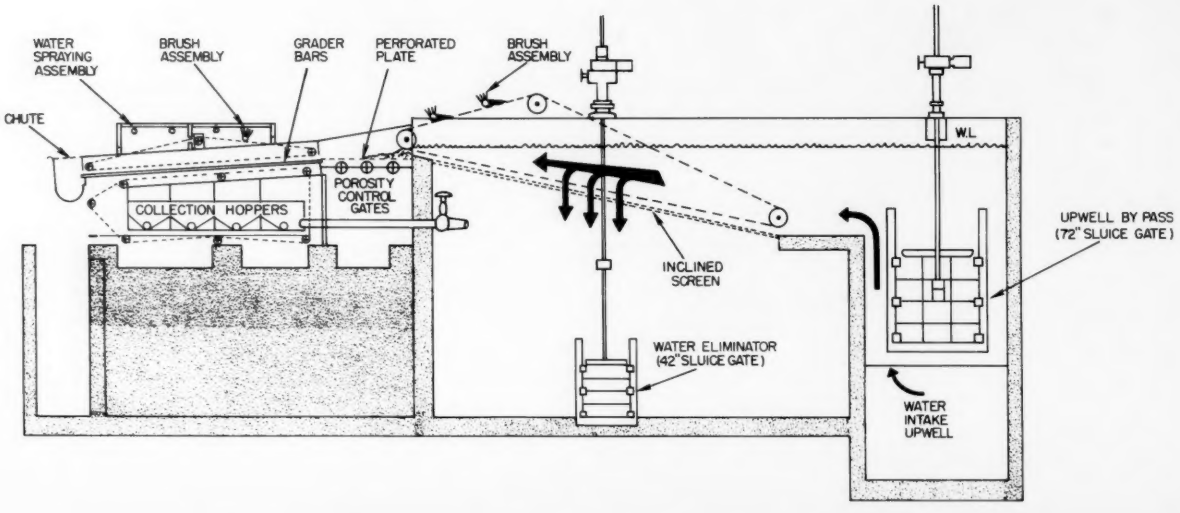
Ongoing research on orifice efficiency at Lower Granite Dam indicates that the 8-inch orifices will pass migrating fingerlings more readily than the 6-inch orifices in use at Little Goose Dam[1].

Once fingerlings pass through the orifices, they are carried in a flume-like channel or gallery (6 feet wide by 7 feet deep) to the south end of the powerhouse. At this point, they pass over a stop-log weir into a water-filled chamber that descends to the tailrace level (about 66 feet vertical), where they are carried to the collection facility (a distance of 400 yards) through a 42-inch diameter concrete pipe. The average water flow in the pipe is about 250 cubic feet per second at an approximate velocity of 25 feet per second.

The two 8-inch orifices per gatewell and the open flume or gallery at Lower Granite Dam are vast improvements over the single 6-inch orifice per

[1]Richard F. Krcma, NMFS, Tri-Cities Airport, Bldg. 57, Pasco, WA 98301, pers. commun.

Figure 5.—Cross section of upwell and fish grader unit at Lower Granite Dam.



gatewell and closed pipe system in use at Little Goose, Lower Monumental, and John Day Dams. Egress from gatewells is facilitated because fingerlings have to pass through only 9 inches of straight pipe into a well-lit flume instead of several feet of elbowed pipe into a dark transport pipe. In addition, much of the debris that continually plugs the 6-inch orifices readily passes through 8-inch orifices. Further, the open flume permits ready access to any plugged orifice, whereas the closed systems require the use of scuba divers for debris removal.

### Upwell and Fish Grader

As at Little Goose Dam, fish emerge from the upwell at the terminus of the transport pipe, are graded by size, and pass into the fish holding raceways. The design and operation of the upwell and fish grading systems at both dams are basically similar. Some modifications of the facility at Lower Granite Dam were necessary to handle the eightfold increase in water volume. Other modifications were incorporated to improve the overall system. Basic features of the system are shown in Figure 5. The following are the major differences from the system at Little Goose Dam:

1) A large inclined screen unit was installed in front of the perforated plate to offset the eightfold increase in water volume. The screen unit construction, including a sweeping mechanism to prevent plugging by debris and algae, was patterned after an earlier screen described in detail by Kupka (1966). Manual or automatic regulation of water over the screen is provided by a 42-inch sluice gate beneath the screen. The excess water is passed back to the river.

2) A 72-inch sluice gate in the upwell provides a means of returning the entire flow back to the river before it passes over the inclined screen and fish grader. The entire flow is normally diverted directly to the river when fish are not migrating or not needed for collection.

3) The length of the fish grader has been increased to 20 feet, and a fourth water-filled hopper was installed under the grader bars. This modification provides a finer degree of size grading. Adult salmon and trout that fail to fall through the grader bars enter a chute at the end of the grader and are discharged back to the river.

4) A chain-driven trash sweeping device installed directly above the grader bars prevents the accumulation of water-borne debris. (This is in addition to the standard traveling debris collector between the grader bars and hoppers.) The new device consists of a bristle brush attached to an angle iron frame, suspended between two chains operating on guide bars and idler sprockets. Operation of this trash sweep can be controlled either manually (using a starter switch) or automatically (by means of an electric timer that regulates the operating interval). A limit switch ensures that the brush assembly will stop at the same point above the grader bars after each operation.

5) A water spraying assembly, consisting of evenly spaced yard-type sprinkler heads connected by pipe, is located above the grader bars. This assembly provides a constant film of water on the grader bars, allowing easier and faster movement of fish down them.

### Fish Holding Area

The size and configuration of the fish holding raceways and the method of crowding are the same as previously described for Little Goose Dam, but some basic improvements have been incorporated. The raceways at Lower Granite Dam are above the level of the fish marking facility and the truck loading area, thereby providing complete movement of fish to these areas by gravity flow. This design provides easier movement of fish and eliminates injuries which may occur with pumping. The last 2 feet of the downstream end of each raceway floor has been lowered 1 foot to provide a basin near the outlet pipe. This modification provides easier removal of the last few fish in each raceway by allowing complete drainage of the raceways—thereby congregating the remaining fish closer to the outlet pipe.

### Fish Marking and Laboratory Facilities

The fish marking and laboratory complex is immediately downstream from the fish holding raceways (Fig. 6). The complex consists of: 1) a marking and sorting facility—wooden building with a concrete floor (1,024 square feet) and 2) laboratory, office, and related facilities—two mobile homes (720 square feet each), connected to each other and the marking facility by an enclosed porch.

During the sorting and marking operation, fish are transferred from the raceways by means of a 6-inch diameter fiber glass pipe running underground to a 1,000-gallon holding tank in the marking facility. From there, fish are placed into a sorting trough containing a temperature-controlled recirculating anesthetic bath and examined for previous marks and condition. Previously marked and poor quality fish not used for the transportation experiments are sent through a 3-inch diameter polyvinyl chloride (PVC) pipe, either directly to the transport truck or to an outside holding tank to recover from the anesthetic before being returned to the river. Unmarked fish to be used for the transportation experiments are sent through one of four 3-inch diameter PVC pipes to a marking station for adipose fin removal, freeze branding, and injection of a magnetic coded wire tag into the cartilage of the snout. The freeze brand and wire tag identify each experimental group, whereas the adipose fin clip simply indicates the presence of a wire tag in the fish's snout. After completion of the marking process, the fish are sent through an electronic detector head that automatically rejects any untagged fish, thereby ensuring that only properly wire tagged fish are used in the transportation experiments. To inhibit fungal growth, properly tagged fish enter a 20-foot section of 3-inch diameter PVC pipe containing a recirculating, temperature-controlled solution of malachite green. At the end of this pipe, the fish pass over a screen device, that eliminates the malachite solution, and into a 6-inch diameter

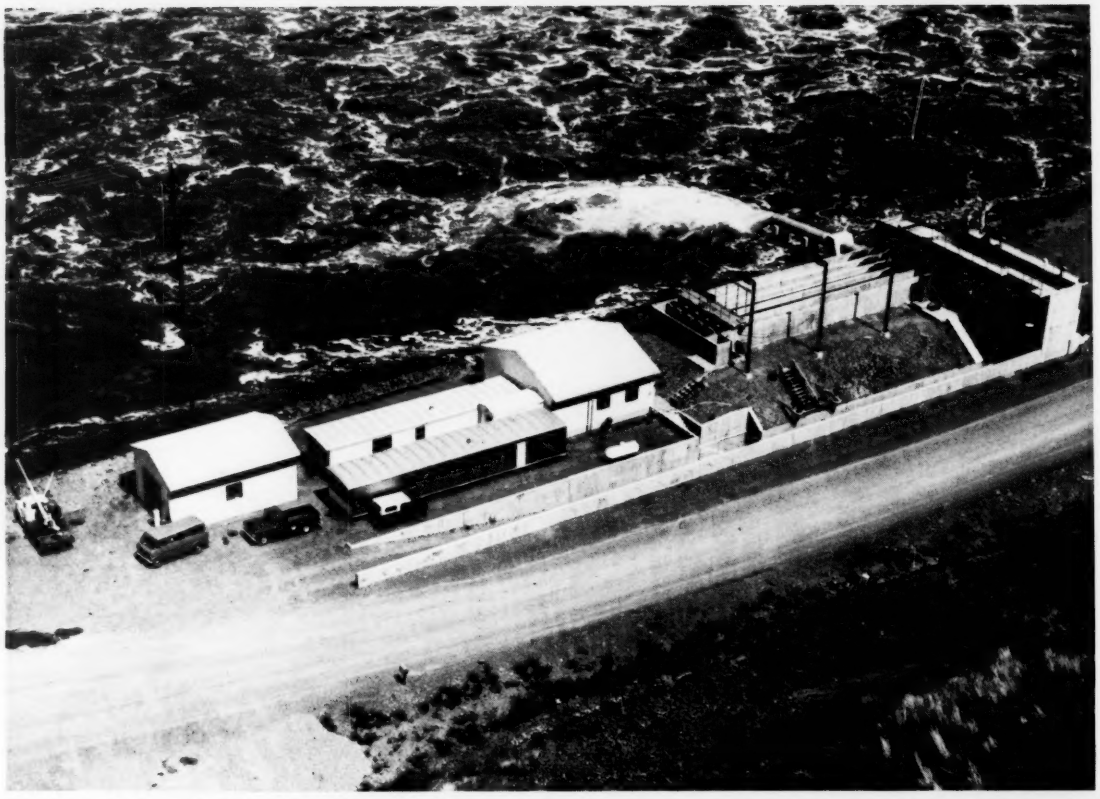


Figure 6.—Overall view of fish holding and marking facility at Lower Granite Dam (shown from left to right are: shop, laboratory and office buildings, marking facility, fish holding facility, and upwell and grader units).

fiberglass pipe containing fresh running water that carries them to the truck.

## SUMMARY

The improved fish diversion, bypass, and collection systems at Lower Granite Dam operated satisfactorily in 1975-76. The automatic counting and gravity flow loading features make this facility ideally suited for mass-collection and transportation of large numbers of downstream migrating salmonids. This system is part of a continuing cooperative effort between NMFS and the U.S. Army Corps of Engineers to improve fish passage on the Columbia and Snake Rivers.

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MFR PAPER 1257

# Care and Maintenance of Squid Quality

R. J. LEARSON and V. G. AMPOLA

## INTRODUCTION

The squid resources of the Atlantic may eventually represent a substantial fishery for U.S. fishermen (Rathjen, 1973; Ampola, 1974; Lux et al., 1974). One current problem associated with this fishery is a general lack of knowledge in the proper handling of squid at sea and through the processing and distribution stages. Typically, squid is handled as an incidental catch by fish trawlers and treated the same as finfish. The trap fishery for squid is primarily a small-boat fishery, and the catch is sometimes not iced at sea. In southern New England, it has been common practice to pack squid in barrels with either ice or ice and seawater.

If not handled properly, squid undergoes rapid spoilage, usually beginning with a discoloration of the flesh (yellowing) followed by a sour odor. In advanced stages of spoilage, ammonia is readily detectable. Another problem area is mechanical damage. Bulk icing, shoveling of the catch, and dense packing of squid all lead to crushing of the squid, broken ink sacs, and broken and torn skin, detracting from the appearance as well as the overall organoleptic quality.

## EXPERIMENTAL RESULTS

### Icing

Tests were carried out at this Laboratory on the iced shelf life of squid. From May to September, commercially caught samples of both *Illex illecebrosus* (summer squid) and *Loligo pealei* ( bone squid) were transported to the Laboratory and iced in boxes with different squid-to-ice ratios—1:1, 2:1, and 5:1. Each day, samples were examined by a raw-evaluation panel in the Laboratory for spoilage. The following table shows the number of days to the onset of spoilage after catch as determined by odor and appearance by a Laboratory panel.

| *Sample* | *Squid-to-Ice Ratio* | | |
|---|---|---|---|
| | *1:1* | *2:1* | *5:1* |
| *Illex* (Gloucester day boat) | 5 | 5 | 4 |
| *Illex* (Pt. Judith Trawler) | 8 | 8 | 7 |
| *Loligo* (Pt. Judith Trawler) | 6 | 6 | 3 |
| Average | 6.3 | 6.3 | 4.7 |

In general, these tests indicate that squid spoils more rapidly than finfish and must be handled very quickly and kept well iced at all times.

Another series of tests were carried out on the iced shelf life of *Loligo* caught in the winter months by the *Valkyrie* out of New Bedford, Mass. The squid were iced immediately after catch at about a 2:1 squid-to-ice ratio. Samples were set aside in boxes from each day's catch and, upon landing, were transported to the Laboratory for evaluation. In all, 17 determinations were made from three trips with the onset of spoilage averaging 9 days after capture. It should be noted, however, that the laboratory samples used in these tests were boxed at sea after capture, and the indication was that the bulk-held squid iced in pens for commercial use were damaged physically in comparison with the boxed squid.

One potential method of holding squid is chilled seawater (CSW) (Karsti and Blokhus, 1966; Hulme and Baker, 1977). Recent research on the use of CSW systems for holding mixed species and herring in bulk quantities aboard vessels showed that the softer fleshed species such as whiting and herring maintain excellent quality and undergo relatively less mechanical damage using a mixture of three parts fish to one part seawater and one part crushed ice in an insulated hold or tank (Baker and Hulme, 1977). Chilled seawater systems aboard vessels have the potential of cooling squid rapidly and holding them at low temperatures with a minimum of physical damage.

A series of tests were carried out cooperatively with a commercial trawler, the *Jeanne D'Arc*, and Ocean Crest Seafoods in Gloucester, Mass., to determine the feasibility of CSW holding of squid at sea. Four tests were completed in which squid held in CSW were compared to samples boxed at sea using a 2:1 squid-to-ice ratio and to penned squid handled in the normal commercial manner (approximately a 3:1 squid-to-ice ratio). An insulated plastic tank capable of holding about 300 pounds of squid was used for these tests using a 3:1:1 squid-to-ice-to-seawater ratio.

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Prior to beginning the fishing operation, the tank was charged with 100 pounds of ice and 100 pounds of seawater. On the first day of fishing, 300 pounds of squid were stored in the CSW tank, and a duplicate sample was boxed according to the experimental outline. Upon landing, the CSW tank and the boxed samples were brought to the Laboratory for testing along with a corresponding sample of the penned squid which were all caught during the last 2 days of fishing. All the samples were re-iced, if necessary, and held until they were considered to be of poor quality by our raw-evaluation panel.

The following table shows the results of these trials indicating the total number of days after capture until the squid were considered to be of unmarketable quality by the Laboratory panel.

| *Holding method* | *Trial* | | | | |
|---|---|---|---|---|---|
| | *1* | *2* | *3* | *4* | *Avg.* |
| CSW | [1]4 | 8 | 7 | 7 | 7.3 |
| Boxed at sea | 6 | 7 | 5 | 6 | 6.0 |
| Penned at sea | 5 | 5 | — | — | 5.0 |

In general, these results indicate that the CSW method of holding resulted in an extension of shelf life over the other two methods. Not only did the squid maintain a higher overall quality, but also the physical condition was better. After 3 or 4 days at sea, the CSW-treated squid were remarkably different in outward appearance. The color of the skin was whiter, most of the squid were still in rigor, and instances of crushing and broken skin were virtually eliminated. These results definitely show that CSW holding of squid is worth investigating for large-scale bulk holding.

[1]Not enough ice was used in this test, and the temperature of the CSW reached 46°F (8°C); therefore, this result was eliminated from the average calculation.

### Freezing

Studies on the acceptability of frozen squid indicate, in general, that both species of squid have excellent freezing characteristics provided 1) the initial quality is high and 2) they are frozen rapidly. Results of frozen storage tests carried out at the Laboratory show that both whole squid and cleaned squid (*Illex*) were still rated good by taste panels after 13 months of frozen storage at 0°F (−18°C). Another series of tests on *Loligo* showed similar results. Additional tests indicated that thawing and refreezing does not substantially reduce overall quality. Whole squid frozen for periods up to 1 year can be thawed, cleaned, processed into breaded strips, and refrozen with an expected frozen shelf life of 6-12 months. Of course, the time spent in thawing, processing, and refreezing should be kept to a minimum to prevent quality losses.

## RECOMMENDATIONS

Some general recommendations can be made for the maintenance of squid quality

### Icing

1) The catch should be iced immediately after capture.

2) Squid should be shelved or boxed to reduce physical damage.

3) Squid-to-ice ratios should not exceed 3:1. A 2:1 ratio is recommended, if possible, with the squid and ice well intermixed.

4) CSW systems should be investigated on a commercial scale using a 3:1:1 squid-to-ice-to-water ratio.

5) All sorting and processing should be carried out rapidly taking care to maintain as low a temperature as possible.

### Freezing

1) Only good-quality squid should be frozen.

2) The containers and cartons should be relatively thin to promote rapid freezing.

3) Plate freezing or blast freezing is recommended with adequate spacing to promote efficient heat removal.

4) Storage temperatures of 0°F (−18°C) or below are necessary.

5) All thawing, processing, and refreezing operations should be carried out as rapidly as possible to prevent quality losses.


## ACKNOWLEDGMENT

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MFR PAPER 1258

# Oysters in the Pacific Northwest

W. P. BREESE

In the Pacific Northwest, oyster farming is essentially limited to the production of the Pacific oyster, *Crassostrea gigas*, a species introduced from Japan in the early 1940's. Since the mid-1950's, production of this species has fluctuated between 8 and 11 million pounds annually.

Oystermen usually obtain wild "seed" of Pacific oysters from Japan, Washington, or Canada. Seed is commonly spread on the bottoms of estuaries, and the oysters tended for 2-3 years until they attain marketable size. "Off-bottom culture" of oysters using rafts, trays, or "hanging cultches" is practiced by some oystermen; mortality and time required for maturity are reduced by off-bottom cultural methods.

Oysters feed on minute plants called phytoplankton that the animal filters from the water. The growth is frequently determined by the available phytoplankton. Only certain types of phytoplankton are suitable for food and oysters must compete with many other marine animals for food. The supply of phytoplankton is determined by the natural productivity of the water and the absence of environmental contaminants.

Human demands on the estuarine waters increase the potential of oyster mortalities. Recreational use, industrial development, shipping and a growing population near the sea decrease the probability that estuaries can remain suitable for the cultivation of a semi-domesticated oyster. In a complex environment, the oyster grower must have complete control over the entire life cycle of the oyster. In short, the oyster must be domesticated before the art of growing oysters can be turned into a highly productive and predictive aquaculture industry.

A start toward domestication of the oyster was made when oysters were artificially propagated in commercial hatcheries. Artificial propagation permits the genetic selection and the production of superior races adapted to various culture and harvest techniques. Work on selective breeding of oysters is in progress and is the important first step in the developing of a predictable oyster industry.

The second and probably most difficult step in completing the domestication of the oyster will be the development of a satisfactory artificial ration. Currently, culture of oysters depends entirely on the natural production of plankton in estuaries; to utilize the natural production requires much space for oyster beds, and subjects the oysters to pollutants and to unstable food supplies. While cornstarch and other materials have been used to fatten oysters, no artificial ration has been developed that will permit commercial production of oysters in a manner similar to the production of livestock in feed lots.

Let me speculate on a third step in the development of an oyster culture. After a suitable diet is developed for oysters, it will be possible and probably desirable to raise oysters under artificial conditions. I have termed this practice "out-bay culture." Oysters raised in large containers outside bays will permit the oyster grower to exercise greater control over oyster growth and mortality. Out-bay culture will provide a measure of protection against storms and environmental contaminants. Additionally, it will allow a grower to control salinity, water flow, food rations, and temperature.

The three steps I have outlined are major developments that must occur before the oyster culture can become a dependable and predictable industry. Even these major steps are not sufficient to stabilize the market for oysters. The oyster industry needs an oyster that can be marketed during the summer. This "summer oyster" would make oysters a food for all months of the year.

Research aimed at making oyster culture a highly predictable aquaculture practice will pay large dividends. Many of the techniques developed for oysters will probably be transferred to the culture of clams. However, the development of a predictable oyster culture cannot proceed at a leisurely pace. Estuaries are being developed at a rapid pace. Oyster culture must develop beyond the present status of a marginal industry to retain a share of the estuarine resource. The challenge and the opportunity exist to develop greater quantities of oysters and clams by increasing our knowledge of oysters.

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# More Than $10 Million Paid to Fish in U.S. 200-Mile Fishery Conservation Zone

Foreign nations have paid the United States more than $10 million for fishing within 200 nautical miles of the U.S. coast this year, Secretary of Commerce Juanita M. Kreps has announced. The 1977 payments were due 1 May from nations already fishing within the zone. Payments are for fees charged under the Fishery Conservation and Management Act of 1976 and include both permit fees, based on vessel tonnage, and poundage fees. Payments are made to the General Treasury.

The largest total fee—fully $5,842,626—was paid by Japan, which has the largest poundage allocation. Japanese ships will be permitted to catch 1,190,960 metric tons of fish during the year within the U.S. 200-mile zone. The Second largest fee—$3,567,224—was paid by the Soviet Union, which has been allocated 648,700 metric tons. The Japanese allocation is primarily for pollock, and the Soviet allocation primarily for pollock and hake, two species that are not sought by U.S. fishermen.

Other nations which have paid fees, and the amount of catch allocated to them, are: South Korea, $366,828, 81,190 metric tons; Poland, $245,672, 64,460 metric tons; and Bulgaria, $55,380, 8,070 metric tons. In addition, $176,147 is due from Spain for 14,400 metric tons and $25,816 from Taiwan for 5,510 metric tons.

Another estimated $350,000 in fees is expected later in the year when Romania, the German Democratic Republic, the Federal Republic of Germany, France, and Italy begin their fishing operations.

The 1977 allocations were made to foreign nations from totals remaining after determining the total catch for each species that would permit the fish stocks to be maintained in a healthy condition, and after subtracting the estimated U.S. catch of each species.

The total amount of fish allocated to be caught by foreigners in 1977 is approximately 2.04 million metric tons. In 1974, foreign fishing vessels caught about 3.3 million metric tons within 200 miles of the U.S. coasts.

The fee schedule provides for a fixed annual fee of $1.00 per gross registered ton (GRT) for any vessel catching, taking, or harvesting fish. A fixed annual fee of 50 cents per GRT, up to a maximum of $2,500, is charged for "factoryships"—those that process but do not catch fish. A fee of $200 per vessel is levied on vessels that assist the fishing and processing vessels.

The 1977 poundage fee is 3.5 percent of the 1975 ex-vessel price (price of the fish as sold at the dock)—the latest published record in the United States. Charges by country are based on allocations so they can be collected in advance as the law requires. If the actual catch is substantially lower than the amount allocated, the foreign nation can apply for a refund. Catch will be determined by U.S. observers on board some foreign fishing vessels and by vessel records.

## Pacific Northwest Salmon Plan Amendments Okayed

Revised regulations for managing salmon fisheries off the Pacific Northwest coast, to help conserve chinook salmon stocks and give commercial trollers a longer season, have been announced by Secretary of Commerce Juanita B. Kreps.

The revisions permited midseason commercial troll fishing from 1 to 15 June (2 weeks longer than previously), and increased the minimum size for commercially caught chinook north of Tillamook Head from 26 to 28 inches. They also extended the rights of the Makah Indians to include an all-species season from 1 May to 1 October, running seaward from the Makah Reservation about 50 miles to the proposed international U.S.-Canada fishery boundary. They went into effect at midnight, 24 May.

Salmon fishery management regulations were instituted by Secretary Kreps as an emergency action on 26 April. Designed to produce optimum yield for U.S. commercial and recreational fishermen, the plan was prepared by the Pacific Fishery Management Council. Upon instituting the plan, Secretary Kreps suggested that the Council consider certain changes to the plan. Those of her suggestions that the Council adopted are contained in the announced revisions.

The original regulations, as approved, were expected to increase the number of harvestable fall chinooks that return to the Columbia River system by 23 percent and the number of coho returning to the system by 2 percent. Also, the 1974 commercial catch of approximately 595,000 coho salmon was expected to be reduced 18 percent by closing the season north of Point Grenville 45 days earlier than previously and by requiring the use of barbless hooks. Recreational catch of chinook and coho north of Tillamook Head is not expected to change from the numbers of fish caught last year, the first season when recreational fishing was under similar regulations.

The Secretary suggested to the Council, however, that it consider possible further restrictions on recreational fishermen. The major aspects of the regulations are listed below.

North of Tillamook Head, Commercial Troll Fishermen: Early season for chinook from 1 May through 15 June; All-species season from 1 July through 15 September, and a late season all-species fishing season from 16 September to 31 October south of Point Grenville; A 28-inch minimum size for chinook and a 16-inch minimum size for coho.

North of Tillamook Head, Recreational Fishermen: All-species season Saturdays closest to 1 May through 31 October; A 24-inch minimum length for chinook, 16-inch minimum length

for coho; One rod per fisherman; A three-fish daily bag limit.

South of Tillamook Head, Commercial Troll off Oregon: Oregon chinook season 1 May-31 October; Oregon coho season 15 June-31 October; Minimum size 26 inches for chinook; 16 inches for coho.

South of Tillamook Head, Commercial Troll off California: California chinook season 15 April-30 September; California coho season 15 May-30 September; Minimum length 26 inches for chinook, 22 inches for coho.

South of Tillamook Head, Recreational Fishermen, Oregon: Season 1 May-31 December; No size limit; One rod; Bag limit of three fish. For California: Season, all year north of Tomales Point; Saturdays, closest to date of 15 February through 15 November south of Tomales Point; 22 inches minimum size; Daily limit of three fish, two of which must be greater than 22 inches and one between 20 and 22 inches.

## NOAA SHIPS SPEND MORE TIME AT SEA

The National Oceanic and Atmospheric Administration's Seattle, Wash., based ships are spending less time in port these days. Operating schedules for some of the 10 research and survey vessels have been extended to allow NOAA scientists to conduct a growing number of environmental research projects.

The ships range in size and type from the 95-foot (57-meter) fishing vessel *John N. Cobb* to the sister ships *Oceanographer* and *Discoverer*, 303-foot (182-meter) ships especially designed for oceanographic research. The 10 Seattle-based ships, and three others that operate out of Honolulu, San Diego, and Juneau, are managed by the Pacific Marine Center in Seattle, part of NOAA's National Ocean Survey.

A NOAA ship's normal "season" has been 180 days at sea. Time in port is necessary for maintenance, repairs, fueling, reprovisioning, crew changes, training, or simply because winter weather is unfavorable either to navigation or research. But now, largely because of major environmental projects that NOAA has undertaken, and because of the Commerce Department agency's responsibilities under the new law extending jurisdiction of the U.S. resource zone to 200 miles, the ships will spend more time at sea. The ships' in-port times have also been staggered, so that they are rarely all at home at once.

This year, the *Discoverer* will spend a total of 210 days at sea, working on the Outer Continental Shelf Environmental Assessment program. This study, being conducted by NOAA's Environmental Research Laboratories for the Interior Department's Bureau of Land Management, is aimed at evaluating the potential environmental impact of oil development on the Alaskan continental shelf. It includes research in Puget Sound, a probable route for oil tankers carrying Alaskan crude to refineries.

The *Miller Freeman*, a 215-foot fisheries research vessel, has had its schedule extended to 250 days for outer continental shelf and extended jurisdiction projects. Because of the increased demands on the ship and its personnel, NOAA has also supplemented its crew. The *David Starr Jordan*, which operates out of San Diego, and the Honolulu-based *Townsend Cromwell*, have also had their schedules extended to 250 days.

The *Surveyor*'s season has been extended to 210 days for the outer continental shelf project and also for extended jurisdiction work. "Extended jurisdiction," explains Commander Mike Fleming of the Pacific Marine Center, "means extended effort for NOAA." The extended jurisdiction is jurisdiction over living and nonliving resources. If a resource exceeds U.S. needs, other nations may harvest the surplus. In the case of living resources—fisheries—research is needed to determine the standing stock of different species, as well as the health of that stock, to decide how much it can be fished. "In the case of mineral resources," Fleming continues, "we need to know how mining or drilling will impact on the environment."

NOAA's National Marine Fisheries Service has responsibility for protecting marine mammals—whales, seals, and porpoises. All NOAA ships now keep records of marine mammals they happen to sight. In addition, the *Surveyor* and *Discoverer* dedicate a month to study of marine mammals. The *Surveyor* has proven especially valuable for such studies because it carries a helicopter. People on the ship had no way of knowing how the presence of the ship affected their counts of porpoises or whales. So while the ship makes its normal transects of a section of ocean, observers on the helicopter watch from above to see how the animals react to the ship—whether they approach it or flee.

## Tuna Fishing Enforcement Regulations Clarified

A clarification regarding the enforcement of regulations for tuna fishing on porpoise now permits fishermen to continue a set on porpoise even if eastern spinner—a depleted species—is identified after the set has begun, the National Marine Fisheries Service has announced.

Regulations provide that schools that contain eastern spinner cannot be encircled with a purse seine net. Under the clarification, when the tuna boat captain is satisfied that a school does not contain eastern spinner, he may begin his set. If eastern spinner are subsequently sighted and accidentally encircled or killed in the course of completing the set, this will not be cause for issuance of a notice of violation provided all other procedures required by applicable regulations have been followed.

The number of eastern spinners which is encircled or killed during the fishing operations will be recorded and this policy will be reviewed periodically to see its effect on the spinner population.

The clarification results from hearings held last fall, during which testimony was presented on the difficulty of identifying different species and on the degree of error in attempting identification. At the hearing it was established that in a small percentage of sets

an unintentional and accidental mortality would occur. Under the law fishermen would, as a result of such unintentional taking, be subject to penalties under the Act. Moreover, there is evidence that once a set involving porpoise has begun, aborting the set is extremely difficult, if not impossible, and there may be more harm done to porpoises by attempting to abort the set than by continuing it.

Following the close of testimony, both the Environmental Defense Fund and the Marine Mammal Commission recommended to NMFS that an accidental take of up to 6,500 eastern spinners be permitted.

## USSR-U.S. Cooperate in Fishery Research

A National Marine Fisheries Service (NMFS) team of eight biologists from the Northeast Fisheries Center Laboratories in Narragansett, R.I., Sandy Hook, N.J., and Woods Hole, Mass., was in Moscow from 17 to 21 January to discuss the joint U.S.-USSR program of fisheries research in the northwest Atlantic within the new U.S. 200-mile fisheries zone. The U.S. scientists met with Soviet specialists from the All-Union Scientific Research Institute of Marine Fisheries (VNIRO) and the Atlantic Institute of Marine Fisheries and Oceanography (AtlantNIRO).

The director and other top officials of VNIRO opened the meetings with a review of their current research on fisheries production and assessment and of current and proposed environmental studies. The U.S. team began its presentation with a call for the continuation of scientific studies, the systematic sharing of survey work, and the initiation of a series of joint scientific workshops.

Following a review of current U.S. research on fishery assessment and environmental and ecosystems studies, Richard Hennemuth, head of the U.S. team, introduced the overall program of the Northeast Fisheries Center. In particular, the U.S. team stressed six areas of U.S.-USSR cooperative research in fish life history studies: 1) Investigation of movements, stock intermixing and mortality rates; 2) age validation on studies for silver and red hake; 3) food habit studies; 4) silver and red hake life history studies; 5) hydroacoustical testing to improve surveys of pelagic species; and, 6) the continuation of Soviet studies aimed at determining the area and time of squid spawning.

The U.S. team also noted the mutual interest in studying marine ecosystems in order to develop prediction models of fish biomass and distribution. Two areas proposed for this study were Georges Bank and the Gulf of Maine. For 1977, three Soviet cruise periods were suggested: 15 May-15 June, 15 July-15 August, and 1 October-5 November.

The U.S. team recommended a series of joint workshops and suggested the following schedule for 1977: 1) 10-20 April at Szczecin, Poland (the plankton sorting and identification center); 2) 15-20 June, also at Szczecin (a workshop on larval herring); 3) 15-20 December at Narragansett, R.I. (a workshop on larval fish food and ecosystem model development).

The U.S. delegates added that fishery specialists from other countries might also be invited to participate in these workshops to maximize the exchange of scientific data. There seemed to be a general feeling among the U.S. scientists, and perhaps among the Soviet participants as well, that it would be pointless for the USSR and United States to organize scientific research in northwest Atlantic waters without the participation of other nations that were already doing similar important research in the area.

The U.S. team also brought up the possibility of establishing a routine procedure for processing and analyzing samples from commercial catches, noting that such a procedure would be essential for checking the adequacy and accuracy of data supplied by foreign fishing fleets, a responsibility of NMFS. The Soviets agreed in principle that such a uniform procedure would be useful. To facilitate communications, the United States proposed the establishment of a telex link between AtlantNIRO and the Northeast Fisheries Center. The Soviets agreed that better communications were necessary, but pointed out that certain "technical difficulties" would have to be overcome before the proposed link could be established.

Discussions among scientists interested in environmental matters and pollution were completed on 20 January. Both sides agreed to exchange reprints and publications on these subjects. The kinds of field research which might be mutually supportive of the environmental programs in the United States and Russia were also discussed, but no definite arrangements were made for cooperative work at these meetings. (Sources: U.S. Embassy, Moscow; Memorandum, Chief, Division of Environmental Assessment, Sandy Hook Laboratory, NMFS, NOAA; IFR-77/25).

According to the NMFS Office of International Fisheries, the U.S.-USSR joint fisheries research program in the northwest Atlantic began a decade ago. In 1967, the United States and the Soviet Union, for the first time, included provisions for cooperative research programs in the Mid-Atlantic bight in a bilateral fisheries management agreement.

To date, more than 200 United States and Soviet scientists and officers and the crews of 13 research vessels have participated in 49 cruises and in the development of research programs. About 100 major studies have been generated entirely or in part by the data accumulated during the cruises. Research vessel findings on species distribution and abundance have become an important part of the data base used for resource assessment in the entire northwest Atlantic.

Surveys and related studies on the fishing power of various trawls have been the key elements of the program. In addition, significant studies have been made on the development of fish stock surveys and on the spawning, growth, feeding, and mortality of major species such as cod, silver hake, red hake, yellowtail flounder, and redfish.

United States scientists and vessels have been affiliated primarily with the

NMFS Northeast Fisheries Center in Woods Hole, Mass. Soviet scientists and vessels have come from AtlantNIRO in Kaliningrad on the Baltic Sea.

## *Jellyfish Research May Aid Swimmers, Fishermen*

Research into the toxins contained in the venom of the Portuguese man-of-war, or jellyfish—which scientists refer to as cnidarians—is underway at the University of South Florida in Tampa. The aim is to develop both an antiserum to assist persons who have been stung, and an immune serum to protect those likely to be stung, the National Oceanic and Atmospheric Administration reports.

The research, now in its second year, is being carried out by David Hessinger under a grant from NOAA's Office of Sea Grant. The Commerce Department's National Sea Grant Program provides support to colleges, universities, and other institutions for research, education, and advisory services in marine-related areas.

"Most people who are stung are not killed," Hessinger explained. "But the sting is excruciatingly painful and, if stung badly enough, a person may go into shock, drown, or succumb to a heart attack." There are no accurate statistics on just how many people are stung, nor on deaths. However, in a number of fatal instances, the stings have been considered a factor in the fatality, and there have been frequent occasions when beaches have been forced to close down because of the invasion of jellyfish.

Hessinger's work is concentrated on determining the effect of the toxins from the cnidarian venom on cell tissues. The venom from the Portuguese man-of-war is every bit as strong as that of a cobra, he said, but not as dangerous because the sting does not penetrate as far as the fangs. The Portuguese man-of-war stings with a microscopic syringe-like organism at the end of the tentacle which releases the venom. The tentacles on some Portuguese men-of-war are known to have grown to 90 feet in length, Hessinger said, which adds to the danger they pose to unsuspecting divers who might not see anything on the surface near them.

From the public health standpoint, Hessinger's work offers particular promise to three groups of individuals: 1) lifeguards, divers, fishermen, and others whose occupations might force them to work in waters where these organisms might be present; 2) tourists and beachgoers who might be relatively ignorant about the seriousness of a sting and blunder into them while swimming; and 3) individuals who might have a high sensitivity to a sting, such as a person with a heart condition or high blood pressure, or an individual with allergy problems.

As Hessinger sees it, methods ultimately will be developed to help all three groups against the painful stings. With the occupational group, he thinks that eventually a means will be found for injecting nontoxic venom into individuals to let them form antibodies against the venom, thus building up an immunity. For beachgoers he anticipates that a serum can be developed, containing the antibodies, for injection into a victim at the time of the stinging. For those with high sensitivities, Hessinger said, some type of program would have to be worked out through a series of sensitivity tests so these individuals would have a less serious reaction to a sting.

Because of their annual cycle of movement, the marine organisms pose threats in many areas of the world. With the man-of-war, for example, the cycle takes them along the Gulf Stream from the Gulf of Mexico, through the Florida Straits to Miami, and then up the Florida and East Coasts to Cape Cod. There, the animals are picked up by the Labrador Current, which takes them to Plymouth, England and down the coast of Africa to the Equator, where they head west again, passing the Azores to the coast of South America, and north to the Gulf of Mexico.

Unable to swim, the organisms move by sea currents and wind. They use their tentacles to get help from the currents and, through the use of muscular manipulation, they can form a sail out of their float and thus travel with the wind.

## Coast Information Center Planned for New England

A network of coastal information centers for planners, marine resource managers, scientists, and the public will soon get its start with the establishment of the New England Regional Coastal Information Center, located at the University of Rhode Island's Pell Library on Narragansett Bay.

Funds for the new service, in the form of a $50,000 grant, come jointly from three bureaus of the Commerce Department's National Oceanic and Atmospheric Administration: the Office of Sea Grant, Office of Coastal Zone Management, and Environmental Data Service. An additional $25,000 has been pledged by the University of Rhode Island.

The New England center will be a prototype for a system of highly specialized facilities in as many as eight other locations on the Great Lakes and along the Atlantic, Pacific, and Gulf coasts, according to Robert J. Shephard, program manager for Sea Grant's Marine Advisory Service. The centers, said Shephard, will allow members of state agencies, coastal planners, legislators, environmentalists, and the general public to obtain information and guidance on coastal area subjects, including laws and zoning regulations, scientific data, and sources of publications. Shephard added that the regional information centers would be administered through local Sea Grant programs.

In addition to providing information on coastal zone activities to a number of different groups in New England, this first regional center will also act as a referral service, exchanging information and publications among state and local governmental agencies, citizen groups, special interest groups, and the general public on the wide-ranging subjects of coastal resource planning and management.

## *FCMA Curbs Foreign Fish Vessels off U.S. Coasts*

Implementation of the Fishery Conservation and Management Act (FCMA) of 1976 has caused a dramatic reduction in the number of foreign fishing vessels off the coasts of the United States. Preliminary reports from the National Oceanic and Atmospheric Administration (NOAA) indicated that 180 foreign fishing and fishing support vessels were sighted off U.S. coasts during March—a 40 percent reduction from the 435 vessels sighted in March of 1976.

The foreign vessels were sighted only off the coasts of New England and Alaska, whereas prior to the implementation of the 200-mile-limit act on 1 March foreign fishing vessels were found off all U.S. coasts. The ships were from five nations, as compared to 12 nations a year ago.

With the implementation of the 200-mile fishery zone, foreign fishermen are required to have permits specifying the locations, times, and species of fish they may catch.

The March counts were made by representatives of the Commerce Department agency's National Marine Fisheries Service and by personnel of the U.S. Coast Guard, conducting joint fisheries enforcement patrols from Coast Guard aircraft and cutters.

The largest number of foreign fisheries vessels, 87, were from Japan, which had 73 ships off Alaska and 14 off New England. Second was the Soviet Union with 70, of which 46 were off Alaska and 24 off New England. Third was Spain with 21, all of which were off New England. In addition, Coast Guard and NMFS personnel sighted vessels from South Korea and Canada. A summary of foreign fishing vessels operating off the U.S. coasts during March 1977 is given in the accompanying table.

| Area | Nation | No. of vessels |
|---|---|---|
| Off New England | Soviet Union | 24 |
| | Spain | 21 |
| | Japan | 14 |
| | Canada | 1 |
| | Total | 60 |
| Off Alaska | Japan | 73 |
| | Soviet Union | 46 |
| | South Korea | 1 |
| | Total | 120 |
| | Grand total | 180 |

Foreign vessels sighted off the coasts in 1976 were as follows: January-420, February-510, March-435, April-610, May-928, June-970, July-842, August-543, September-514, October-452, November-258, and December-240. In 1977: January-319, February-314, and March-180.

## New Northeast Pacific Chart Printed by NOS

Publication of a new international nautical chart has been announced by the National Oceanic and Atmospheric Administration (NOAA). Prepared by the Commerce Department agency's National Ocean Survey (NOS), the chart, number 50, covers the Northeast Pacific Ocean from Hawaii to the North American continent. It is the final chart of five small-scale metric nautical charts to be issued by NOS as part of a multination international charting program sponsored by the Monaco-based International Hydrographic Organization (IHO).

The scale of the new chart is 1:10,000,000. In addition to showing depth measurements in metric units, the chart shows the newly established Fishery Conservation Zone limits along the continental U.S. coast. The zone around Hawaii, previously not delineated, will be added at the next regularly scheduled printing of the chart.

The IHO program is designed to provide a standard series of nautical charts which can be used and reproduced by all nations. Each member nation is authorized to reprint the charts in native language, but must employ the same form of navigational information, including depth curves, sounding spacing, aids to navigation, and nautical symbols.

The nations which have agreed to produce and issue international charts are: the United States, Canada, West Germany, United Kingdom, France, Brazil, Argentina, Chile, Italy, Netherlands, Japan, India, New Zealand, Australia, and South Africa.

The four previous charts of the series prepared by NOAA's National Ocean Survey are Chart 501, which was published almost 2 years ago and covers a vast area of the Pacific Ocean off the west coast of the United States and Canada; Chart 514, which shows the northern portion of the Bering Sea; Chart 513, which covers the southern portion of the Bering Sea, including the Aleutian Islands; and Chart 500, which covers the northeastern Pacific from Alaska to Hawaii, including the U.S. west coast. The scale of these charts is 1:3,500,000.

The new chart 50 is priced at $3.25, and may be obtained from the NOS Distribution Division (C44), Riverdale, MD 20840; NOAA Chart Sales and Control Data, 632 Sixth Avenue, Room 302, Anchorage AK 99501; National Ocean Survey (CPM14), 1801 Fairview Avenue East, Seattle, WA 98102, or on the U.S. west coast from authorized National Ocean Survey nautical chart sales agents.

## USES SOUGHT FOR SHELLFISH WASTE

Shellfish wastes, now a disposal problem to seafood processors, one of these days may be the source of materials to wrap food, heal wounds, strengthen paper and cloth, and bond paper, wood, and leather. The shells of shellfish contain chitin, a cellulose-like material with great commercial potential, according to Sea Grant researchers at the Massachusetts Institute of Technology. In addition to possible use in the food, medical, and paper products industries, the material also can be used to remove radioactive heavy elements from nuclear power plant wastes and metal contaminants from drinking water.

Interest in chitin and chitosan, one of its derivatives, has taken on new dimensions recently as shellfish processors respond to regulations prohibiting the dumping of untreated shellfish waste in the sea.

"It's an instance where enforcement of pollution requirements may spawn a whole new industry," Benjamin L.

Averbach, of M.I.T.'s Department of Materials Science and Engineering, said. He is investigating ways to produce and use chitosan, funded by the M.I.T. Sea Grant Program, a national matching-fund program of research assistance for colleges and universities. The program is part of the Department of Commerce's National Oceanic and Atmospheric Administration.

Averbach said chitosan, because it readily absorbs heavy metals from both fresh and salt water, can be used to treat industrial waste streams which often contain heavy metals. Among studies at M.I.T. is one investigating the potential of chitosan for use as films for food wraps. These films, Averbach said, are twice as strong as most plastic wraps, and, more importantly, are not dependent upon petroleum products for their manufacture. The scientists also are investigating medical and pharmaceutical applications for chitin and chitosan. Chitosan, Averbach said, may be used in kidney dialysis machines, with the absorptive properties of chitosan membranes removing waste materials from the blood when kidneys are not functioning properly.

Chitin comes from such shellfish as crab, shrimp, lobster, and crayfish. Depending on the species, only 15 to 25 percent of the live weight of these animals is edible. Shellfish processors dispose of the rest by dumping in the sea or taking it to landfills. But dumping has been outlawed and landfill operators dislike the waste material because in its raw form it decomposes slowly.

In a report, "Industrial Prospects for Chitin and Protein from Seafood Wastes," M.I.T. scientists suggest a two-step production mode. In the first, shellfish processors would separate the loosely bound tissue remaining in the shell and process it into a dried protein product as a supplement for livestock feed. The second step is the actual chitin and chitosan production by regional processing plants.

The study suggests that a network of chitin and chitosan plants should be built, each processing shells brought to it from a 50-mile radius. The lack of widely dispersed plants is one reason, the scientists say, why only a small portion of the 110,000-ton annual U.S. shrimp harvest lends itself to such processing.

## *Circulation Studied in Lakes Michigan, Ontario*

Woods Hole Oceanographic Institution in Massachusetts and the University of Wisconsin have been awarded supplemental research contracts totaling nearly $50,000 by the National Oceanic and Atmospheric Administration (NOAA) to study circulation properties in two of the Great Lakes. The awards were made by the Commerce Department agency's Environmental Research Laboratories in Boulder, Colo. Woods Hole received $36,995 and the University of Wisconsin at Madison, $12,171.

Under terms of the contracts, scientists at the Physical Oceanography Department of Woods Hole will continue to analyze various processes in the water circulation patterns of Lake Ontario for use in preparing forecasts of the horizontal and vertical pathways that lake contaminants are apt to follow.

Oceanographers at Wisconsin's Marine Studies Center will continue their analysis of data gathered from a grid of 12 current meters which were suspended in coastal waters of Lake Michigan near Saugatuck last year. These are part of a wider array set by NOAA's Great Lakes Environmental Research Laboratory in Ann Arbor and a midlake set operated by the Center for Great Lakes Studies at the University of Wisconsin, Milwaukee.

Data from the current meters will provide information on coastal currents, influence of atmospheric conditions on these currents, and circulation characteristics in the southern basin of Lake Michigan.

With supplemental funds, a total of $110,020 has been awarded to Woods Hole, $42,671 to the University of Wisconsin at Madison, and $30,000 to the University of Wisconsin-Milwaukee for this continuing study.

## *Andrews Named NMFS Marine Mammals Chief*

Thomas C. Andrews, former Director of Administration in Maryland's Department of Natural Resources, has been named Chief, Marine Mammals and Endangered Species Division of the National Oceanic and Atmospheric Administration's National Marine Fisheries Service, NMFS Director Robert W. Schoning has announced.

In his new position in Washington, D.C., Andrews will be responsible for reviewing and evaluating all marine mammal and endangered species policies and procedures of the Commerce Department agency. He was employed by the State of Maryland as a Water Resources Planner, Natural Resources Planner, and Administrator for about 10 years. Andrews is a native of Ohio, where he received a B.S. degree at Miami University in Oxford. He also holds a M.S. degree from the University of Michigan in Ann Arbor.

## Puerto Rico University Receives First Sea Grant

A program of marine advisory services will be started in Puerto Rico under a National Sea Grant Program grant awarded early this year by the National Oceanic and Atmospheric Administration (NOAA). The grant of $39,900 to the University of Puerto Rico, marks the first time Sea Grant

funds have been awarded in Puerto Rico, according to Ned A. Ostenso, Director of the National Sea Grant Program.

"We are happy to be able to assist the University of Puerto Rico in its efforts to establish an advisory program that will provide assistance to fishermen and others in Puerto Rico," Ostenso said during ceremonies in Washington at which the Commerce Department agency award was presented to Arturo Morales-Carrion, President of the University of Puerto Rico.

Morales-Carrion said this year's Sea Grant program in Puerto Rico "represents only the beginning of what we contemplate in terms of a substantial participation of the University of Puerto Rico in Sea Grant activities.

"The experience the first year," he said, "will serve as a point of departure for future Sea Grant planning and involvement, not only at the University but in Puerto Rico as a whole."

The grant-funded program will provide technical training to marine extension agents who will serve as a nucleus for a corps of marine advisory service specialists. The program will provide fishing skill training for about 250 commercial fishermen on the east and southeast coasts of the island, including the Vieques and Culebra coastal municipalities. Matching funds of $20,132 from non-Federal sources will augment the Sea Grant. The program further is designed to increase public awareness, concern, and appreciation for Puerto Rico's marine and coastal resources, as well as the need for proper conservation measures to preserve those resources.

The Sea Grant activities will be coordinated through a program at Humacao University College, on the east coast of Puerto Rico, in collaboration with the University's Mayaguez campus, which has a marine graduate program.

The east and southeast coasts of the island are characterized, Morales-Carrion explained, by a diversity of marine and coastal environments and ecosystems. In addition to edible fish and shellfish, the area is endowed with innumerable estuaries, rookeries, mangroves, offshore keys, coral reefs, and other living marine systems, he said. The island of Vieques has a spectacular bioluminescent bay, and the coastal waters of Culebra island bear the best coral reefs in Puerto Rico.

Because commercial fishing in Puerto Rico depends largely on bottom fish, Morales-Carrion explained, the conservation of the estuaries, mangroves, coral reefs, and other living marine systems is of great importance to the island's economy.

## Contract Awarded for Marine Studies

Science Applications, Inc., has been awarded a $159,636 contract by the National Oceanic and Atmospheric Administration (NOAA) to help integrate research results from the Commerce Department agency's Marine Ecosystems Analysis Program (MESA). The award was made to the La Jolla, Calif., firm by NOAA's Environmental Research Laboratories in Boulder, Colo., which is coordinating the large, ecological study to assess human impact on marine environments.

MESA currently is conducting three regional projects: the New York Bight Project, the Deep Ocean Mining Environmental Study (DOMES), and the Puget Sound Project. The first MESA study was started because of extremely heavy impact of human activities, particularly ocean dumping, in the New York Bight region.

The other two MESA projects are both based in Seattle, Wash. DOMES was initiated to identify potential environmental problems resulting from deep ocean mining of minerals in the area of commercial interest southeast of Hawaii in the Pacific Ocean, while the Puget Sound study is evaluating the effects of municipal and industrial waste discharges into southern Puget Sound and of increased oil transportation and refining activities on northern Puget Sound.

More than 100 MESA research projects, conducted by numerous universities and other government agencies, are currently underway. They were established to determine the "state-of-health" of regional marine coastal ecosystems where significant management and environmental quality problems exist or are anticipated.

Research results will be used by MESA to advise environmental managers on how to implement and use effective monitoring programs for maintaining continual evaluation of ecosystem quality, and how to strengthen the ability to make decisions concerning conflicting use of marine waters.

From these results Science Applications personnel will provide a variety of documents for final integration and preparation of new or revised MESA program development plans.

## *Import Restrictions on Tuna Extended*

Changes to the regulations governing importation of yellowfin tuna have been announced by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service, a Commerce Department agency. The effective date of an embargo on yellowfin tuna being imported which has not been caught in compliance with the U.S. marine mammal regulations was extended from 1 June to 1 August 1977.

Under the regulations, the Director, National Marine Fisheries Service, must determine that the fish being imported were caught in a manner consistent with the requirements imposed on U.S. fishing operations. Because of the time required to make such a finding and obtain proper import documentation, the 60-day extension was granted to insure the continuous flow of tuna into the country.

Canned tuna marking requirements have been modified so that canned tuna, other than yellowfin tuna, may be imported without documentation if the means used to identify the contents of the can have been approved in advance by the Service. Current regulations require cans to be labeled "Other than Yellowfin Tuna." Because processors' canning codes often identify the species of tuna, the change was made to allow more flexibility in the importation of tuna which did not require documentation.

## Inter-American Development Bank Lends To El Salvadore and Haiti for Fishery Work

The Inter-American Bank has approved a $5.3 million loan to the Republic of El Salvador to increase the production and domestic consumption of fish in the country, according to Bank officials.

The program will improve management for small-scale maritime fishermen associated in cooperatives by providing them with specialized technical support and with docks, modern fishing tackle, and processing and marketing facilities; will stimulate fish farming by building ponds for intensive cultivation of inland fish on about 250 acres of marginal land; and will provide appropriate distribution and sales facilities for eligible small retail dealers.

The program will be carried out in three subprojects: 1) Global credit for maritime and inland fishing, consisting of an overall line of credit to be used by maritime fishermen's cooperatives, small fish dealers, fish farmers, and other beneficiaries; 2) Port facilities subproject, consisting of the construction of unloading installations at Acajutla, El Triunfo, and El Tamarindo, remodeling of existing installations in La Unión, the provision of equipment and installations on land for the La Libertad dock, and related works; 3) Technical support for project execution, consisting of the contracting of consulting services to collaborate with the executing agency and the beneficiaries, especially fishermen's cooperatives.

The total cost of the project is estimated at $6,735,000, of which the Bank loan will cover 78.7 percent and local sources the remaining 21.3 percent.

The Inter-Amercian bank has also approved $687,000 in nonreimbursable technical cooperation to help finance the first stage of a fishery development program in Haiti. The technical cooperation, granted to the Republic of Haiti, will be used by the Ministry of Agriculture to contract research of fish resources, processing, and marketing; the analysis of institutions and human resources; and the identification and prefeasibility study of possible investment projects. The second stage of the project would include a feasibility study for the investment project identified in the first stage.

The project is designed to provide reliable information on the potential of Haiti's fish resources. If their existence and viability is confirmed, these resources will reportedly benefit the lower income sectors of the country. Because of the high cost of meat and fish, the Haitian diet consists basically of cereals. The project will signify a general improvement in the diet of low-income sectors as well as represent a new source of employment, higher income levels for those involved in the work, and savings in foreign exchange that is now used to pay for imports.

The total cost of the two stages is estimated at $919,000. The first stage will take 12 months to complete and will cost $742,000, of which the Bank will contribute $687,000 in the following form: $206,100 in gourdes from the Fund for Special Operations and Can$480,900 from the Canadian Fund. In addition, the beneficiary will contribute $55,000. The cost of the second stage has been estimated at $177,000, of which the Bank would contribute Can$111,300 and $47,000 in gourdes. The Republic of Haiti would contribute $18,000.

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## *IRELAND POSTPONES FISHERY MEASURES*

The Irish Government postponed unilateral fisheries conservation measures which were to have taken effect 1 March 1977. This decision reportedly followed a 1-hour meeting on 28 February 1977 between Irish Fisheries Minister Paddy Donegan and European Community (EC) Commissioner Finn Gundelach. The 2-week postponement of the conservation measures provoked an angry reaction from the Irish Fishermen's Organization (IFO). IFO secretary Frank Doyle, accused the Irish Government of reneging on its pledge to follow an independent fisheries policy despite EC pressures. Fisheries Minister Donegan defended the Government action by implying that postponement of the measures would facilitate a settlement between Ireland and the EC.

According to the NMFS Office of International Fisheries, the Irish Government and the IFO have differed sharply over implementation of a national fisheries policy. Irish fishermen have little faith in EC capabilities to protect fishery stocks from overfishing and favor extension of Ireland's territorial sea to 50 miles. The Irish Government, however, feared EC backlash and loss of support on key issues such as farm prices, should it unilaterally impose measures in the face of strong EC opposition. Despite Government concern for relations with the EC, Irish fishermen will undoubtedly continue to pressure the Government to protect their interests. (Source: IFR-77/38.)

## Japanese Longliner Is Fined $250,000

On 20 January 1977, the Japanese longliner *Fukuyoshi Maru No. 75* entered port at Sitka, Alaska, seeking medical attention for a sick crew member. An inspection team from the U.S. Coast Guard Cutter *Clover* boarded the vessel while it was in Sitka, to inspect its catch and check its compliance with U.S. laws regulating foreign fishing. Coast Guard personnel discovered a box containing six tanner crab carapaces, 29 large pinchers, 63 small pinchers, and 76 leg segments. Retention of the crab violated U.S. laws protecting Continental Shelf Fisheries Resources (CSFR).

Further investigation revealed the retention of five immature chum salmon,

a violation of the International Convention for the High Seas Fisheries of the North Pacific Ocean (INPFC). The INPFC violation was recorded, and the information presented to the Japan Fisheries Agency for appropriate action.

The *Fukuyoshi Maru No. 75* was then seized for violation of the U.S. CSFR laws and placed in the custody of the U.S. Marshal, Sitka. The master was arraigned in U.S. District Court, Anchorage. On 8 February, an out of court settlement for $250,000 was reached. The vessel was allowed to depart U.S. waters on 9 February, and was taken into custody by a Japan Fisheries Agency patrol vessel for the INPFC violation. Japanese authorities subsequently banned the *Fukuyoshi Maru No. 75* from fishing U.S. waters for a period of 30 days.

According to the NMFS Office of International Fisheries, the 499 gross ton longliner is owned by Nemuro Daiichi Gyogyo Suisan Kumiai of Hokkaido, Japan. At the time of boarding, the vessel was carrying about 250 metric tons of sablefish and turbot worth approximately $259,000. The value of the vessel was estimated at about $600,000. The *Fukuyoshi Maru No. 75* departed its homeport of Nemuro, Hokkaido, on 2 November 1976 and arrived in U.S. waters on 30 November. (Source: IFR-77/48.)

## Fisheries of Progreso and Ciudad del Carmen, Mexico

The Regional Fisheries Attache for Latin America, Rolf Juhl, visited the Mexican fishing ports of Progreso and Ciudad del Carmen in February 1977 in the company of U.S. Consul Robert Ashford. Their report deals with the fisheries and the trade opportunities in that area (see map).


### Progreso

Snapper and grouper are the most important species landed in the port of Progreso. Grouper catches are by far the largest and account for 90 percent of all landings there. A fleet of 200 vessels fishes for grouper, while 150 vessels fish for snapper. The snapper fishermen use reels and fish offshore; the grouper fishermen use dories and handlines and fish close to the coast. The snapper fishermen also land incidental catches of grouper.

Catches of snapper and grouper declined in 1976, even though 65 new vessels were added to the fishery (Table 1). The Regional Fishery Attache reports that the addition of such a large number of new vessels with inexperienced crews, managed by fishing cooperatives, caused the average catch per vessel to decline 29 percent in 1976. Catches were also affected by labor disputes between the vessel owners and the cooperative fishermen.

**Table 1.—Snapper and grouper landings in Progreso and the number of vessels in the fishery, 1975-76.**

| Year | Landings (t) | Vessels (no) | Catch/vessel (t) |
|---|---|---|---|
| 1975 | 12,900 | 285 | 45.3 |
| 1976 | 11,300 | 350 | 32.3 |

Source: Productos Pesqueros Mexicanos.

**Table 2.—Shrimp landings in Ciudad del Carmen (tails), 1974-81.**

| Year | Quantity (t) | Year | Quantity (t) |
|---|---|---|---|
| 1974 | 11,000 | 1978 | NA |
| 1975 | 10,000 | 1979 | NA |
| 1976 | 9,000 | 1980 | NA |
| 1977 | NA | 1981 | P 20,000 |

P = Projected
Source: Camara Nacional de Pesca de Carmen

There are nine fish processing companies in Progreso, but three of these process about 50 percent of the port's total landings. Cia, Industrial del Golfo y Caribe S.A. (General Manager, Jose Alonzo Benitez), operates a fleet of 75 vessels. Most of the catch is exported to the United States through Miami. The company's vessels make 20 to 22 trips per year and land between 5 and 10 metric tons (t) each trip.

Pescados Mexicanos, S.A., Progreso, Yucatan (Manager, Alberto Salis Pinedo), operates 40 vessels and the entire catch is processed and shipped to the United States. Productos Pesqueros de Yucalpeten (Manager, Manuel Lopez Garcia) is a subsidiary of the state-owned company Productos Pesqueros Mexicanos (PROPEMEX). It owns and operates 43 vessels, of which 20 are the new fiberglass vessels built by Desco Marine in Chesapeake, Va. PROPEMEX is also using 20 Cuban-built ferro cement vessels to train apprentice fishermen[1].

### Cuidad del Carmen

Shrimp is virtually the only significant fishery in Ciudad del Carmen, accounting for almost 98 percent of all fishery products processed in that port. About 9,000 t of shrimp tails were landed in 1976 (Table 2), significantly less than in 1974 and 1975 due to the cooperative fishermen's strike in September and October. Industry officials predict landings of 20,000 t by 1981.

Mexican vessels which operate on the Campeche Bank are primarily based in the ports of Ciudad del Carmen and Campeche. About two-thirds of the shrimp fleet is based in Ciudad del Carmen which has a better natural harbor.

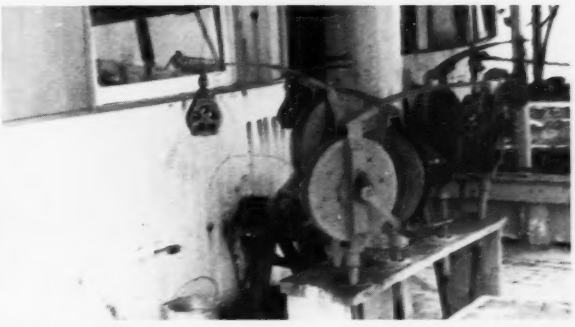
About 1,528 fishermen operated 380 trawlers between 22 and 24 meters (m) long out of Ciudad del Carmen as of February 1977. The port has extensive facilities for constructing and repairing fishing vessels. There are 9 shipyards, 10 machine shops, and 10 vessel repair firms. Juhl visited one of the shipyards, Astilleros del Carmen, S.A. This shipyard was the first to construct steel-hulled trawlers in the area. In February there were three trawlers, 24 m long,

[1]These vessels are owned by the Secretariat of Education and assigned to Mexican fishery schools. PROPEMEX cooperates with the schools by providing training and eventually jobs to the students. For additional information on these ferrocement vessels, request International Fisheries Report 76/93 dated 12 April 1976 from the nearest NMFS Statistics and Market News Office.

Shrimp fleet in port, Ciudad del Carmen, waiting for weather to improve.

Ciudad del Carmen, showing fish docks in protected inside waters.

A grouper fishing boat in Progreso with 10 one-man skiffs which are let overboard in the morning and retrieved in the afternoon.



Hand driven snapper reels admidship of a snapper boat. Reels are placed in sockets along the rail during fishing operation.

under construction. The vessels have Caterpillar-357 engines and cost about $150,000 fully equipped.

There are 10 shrimp processing companies with 14 freezer plants in Ciudad del Carmen. The Regional Fishery Attache provided the following information about three of the processing companies.

Industrial Pesquera Santa Maria, S.A., Calle 20 No. 27, Ciudad del Carmen, Campeche (General Manager, Raul J. Ramirez). This company operates 12 shrimp trawlers and plans to double the size of its fleet. It is currently increasing its processing and freezing capability. In addition, fish-processing equipment is being purchased to utilize the incidental catch of the shrimp trawlers which was previously being discarded at sea.

Isla Camaronera, S.A., Calle 20 No. 1, Ciudad del Carmen, Campeche (General Manager, Felipe Charat). This company operates two processing plants; the plant in Campeche processes shrimp and fish; the plant in Ciudad del Carmen processes only shrimp. The General Manager, who is on the Advisory Board to the Chief of Mexico's Department of Fisheries, has indicated an interest in a possible joint venture with a U.S. company. Charat is interested in the U.S. market as well as U.S. capital and technical assistance.

Camaronera del Carmen, S.A., Ciudad del Carmen, Campeche (General Manager, Federico Gutierrez). This company operates a fleet of 40 shrimp trawlers. It is believed to have the most efficient and modern shrimp processing plant in Mexico. The plant is equipped with a rotating drum to freeze the shrimp individually. No more than 12 of these drums are in operation throughout the world. All the equipment in the plant is made of stainless steel and the walls of the plant are covered with tile for easy maintenance and cleaning.

The Regional Fisheries Attache characterized the fishing industry of Progreso and Carmen as progressive and eager to form partnerships to attract foreign captial and technology. While contacts have already been made with some foreign companies, Mexican businessmen would generally prefer to deal with U.S. companies, especially as most of Mexico's fishery exports are shipped to the United States. Interested U.S. companies should write to Robert Ashford, U.S. Consulate, Merida, % U.S. Department of State, Washington, DC 20520. A copy of all correspondence should also be sent to the Regional Fisheries Attache in Mexico City. His address is Rolf Juhl, Regional Fisheries Attache, U.S. Embassy, Mexico City, % U.S. Department of State, Washington, DC 20520.

## South Africa Eyes Seal Repellents to Save Nets

The seal population off South Africa and Namibia is estimated at about 800,000 animals distributed among 23 breeding colonies situated on various offshore islands and in five areas on the mainland along the west coast. There

seems to be a double incentive for the South Africans to harvest seals in their waters. First, the seals, as a renewable natural resource, form the basis for a small but profitable industry producing valuable furs and oil. Secondly, the fishermen see seals as a menace to their nets and catch.

As a result of protective legislation, the South African seals seem to be in no danger of extinction. However, the methods of harvesting have attracted considerable attention from humane organizations. The U.S. Marine Mammal Protection Act of 1972 prohibits the harvesting by U.S. citizens or importing into the United States of almost all species of ocean mammals. This removes much of the economic incentive for other nations to harvest these species. However, the Secretaries of Commerce and of the Interior can lift the moratorium at their discretion. Therefore, in accordance with the Cape Fur Seal Management Waiver of the moratorium, fur sealskins may be imported into the United States from the 1976 harvest if the take does not exceed 70,000 animals and if all other terms of the waiver, established in February 1976, are met. This waiver does not apply to skins from Namibia.

Seals rob fishermen of thousands of tons of fish each year, both when they get trapped in nets and when they attack schools of fish off the coast. As a result, seals are often maimed and killed by angry fishermen. At one time, each fishing vessel carried two rifles and the crew would shoot any seals in the nets, thus protecting the catch as well as culling the herds. This has been prohibited. One solution to this problem would be to repel the seals from the nets. This is the aim of research conducted at the Central Acoustic Laboratory of the University of Cape Town. The research is largely being sponsored by the Society for the Prevention of Cruelty to Animals. Both the Government (Department of Sea Fisheries) and the South African inshore fishing industry (which contributed about $2,500 as of April 1976) are also helping to promote this research.

Under consideration as seal repellents are two different sounds—that of a killer whale and that of a shot fired into the water. An inexpensive device, which could be installed in the fishing vessels and operated by pressing a button, would need to be developed for broadcasting the sounds under water. Unfortunately, the experiments of underwater broadcasting of killer whale calls have not shown good results so far. This may be due to the fact that the recordings were of poor quality and came from a stationary sound. Another possibility is that the mating rather than the attacking whale calls may have been recorded. Thus stereo broadcasting and more experimentation is needed, but a shortage of funds is making further research difficult. The Laboratory, therefore, turned its efforts to investigating the use of explosive shock waves to chase seals away from nets. Firing a bullet into the water repeatedly seemed to accomplish this. A mechanical device which would reproduce this sound inexpensively and effectively remains to be developed. Nevertheless, there is no assurance that this method would remain effective — the seals could eventually become accustomed to the sound and ignore it. (IFR-77/43.)

## Japan's Abalone Industry Changing

Important abalone grounds in the Pacific Ocean are located along the coasts of California, Japan, and China. In Japan, two species of abalone are harvested commercially: *Haliotis gigantea* and *Haliotis japonicus*. Much of Japan's abalone is taken in the prefectures located along the coasts of the Pacific Ocean and East China Sea (Fig. 1), with landings in these prefectures accounting for about 70 percent of total production in 1974 (Table 1).

Yearly catches of abalone remained relatively stable until the late 1960's. The annual average catch for the 10-year period 1956-65 was about 4,800 t. Landings of abalone in subsequent years have been on the increase. A particularly good year for abalone was 1970 when 6,466 t was caught, an increase of 40 percent from the 1955 level of 3,922 t. Since 1970, catches have been decreasing slightly, with 4,971 t reported in 1974 (Table 2). The overall increase in annual catches since 1955 is in part explained by improved artificial spawning methods developed in the late 1960's and early 1970's.

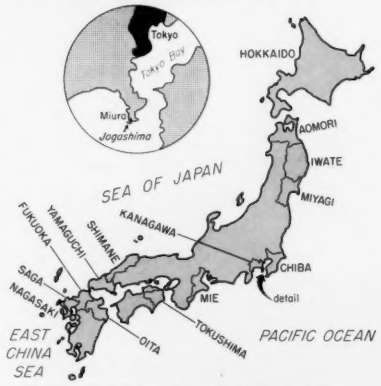


Figure 1.—Japan's abalone producing prefectures.

Most abalone is taken by hand, a method which produces a high-quality,

**Table 1.—Principal Japanese landing areas of abalone, by prefecture and quantity (shell on), 1974.**

| Prefecture | Quantity (t) |
|---|---|
| Hokkaido | 455 |
| Pacific Coast | |
| Aomori | 139 |
| Iwate | 780 |
| Miyagi | 490 |
| Chiba | 650 |
| Mie | 255 |
| Tokushima | 153 |
| Oita | 104 |
| Japan Sea Coast | |
| Shimane | 139 |
| Yamaguchi | 240 |
| E. China Sea Coast | |
| Fukuoka | 121 |
| Saga | 115 |
| Nagasaki | 716 |
| Other Prefectures | 614 |
| Total | 4,971 |

Source: Regional Fisheries Attache, Tokyo.

**Table 2.—Japan's abalone catch (shell on), 1955-75.**

| Year | Quantity (t) | Year | Quantity (t) |
|---|---|---|---|
| 1955 | 3,922 | 1966 | 5,580 |
| 1956 | 3,611 | 1967 | 5,958 |
| 1957 | 3,937 | 1968 | 6,141 |
| 1958 | 4,643 | 1969 | 6,463 |
| 1959 | 4,910 | 1970 | 6,466 |
| 1960 | 4,390 | 1971 | 5,659 |
| 1961 | 3,836 | 1972 | 5,815 |
| 1962 | 4,896 | 1973 | 5,839 |
| 1963 | 4,925 | 1974 | 4,971 |
| 1964 | 4,609 | [1]1975 | 5,416 |
| 1965 | 4,340 | | |

[1]FAO, "*Yearbook of Fishery Statistics*," 1975.
Source: Regional Fisheries Attache, Tokyo.

costly product. Abalone, which has long been a valued food commodity on the Japanese market, sold for an average of US$4.44 per pound (shell on) (¥2,854 per kg) on the Tokyo Central Wholesale Market in 1974.

Although abalone has traditionally been consumed raw in Japan, indications of change in the Japanese market are apparent. Imports of canned abalone have steadily increased since 1970. In 1976, Japan imported about 552 t of canned abalone valued at almost $4 million, mainly from Mexico and Australia. This represents an increase of about 30 percent in quantity from 1970, and almost 300 percent in value (Tables 3 and 4). In contrast, Japan imported about 1,288 t of live, fresh, or chilled abalone in 1976, valued at approximately $6 million (Table 5). (Source: Regional Fisheries Attache, Tokyo, IFR-77/55.)

**Table 3.—Japanese imports of canned abalone, by country, 1975-76, in metric tons and US $1,000.**

| Country | 1975 | | 1976 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| U.S.A. | 1 | 4 | — | — |
| Mexico | 114 | 667 | 77 | 586 |
| Australia | 503 | 2,505 | 459 | 3,136 |
| New Zealand | 5 | 20 | 16 | 97 |
| Total | 623 | 3,196 | 552 | 3,819 |

Source: Regional Fisheries Attache, Tokyo.

**Table 4.—Japanese imports of canned abalone, 1970-76, in metric tons and US $1,000.**

| Year | Quantity | Value |
|---|---|---|
| 1970 | 411 | 956 |
| 1971 | 696 | 2,123 |
| 1972 | 737 | 2,379 |
| 1973 | 1,002 | 3,654 |
| 1974 | 678 | 3,210 |
| 1975 | 623 | 3,197 |
| 1976 | 522 | 3,819 |

Source: Regional Fisheries Attache, Tokyo.

**Table 5.—Japanese imports of live, fresh, chilled, or frozen abalone, by country, in metric tons and US$1,000.**

| Country | 1975 | | 1976 | |
|---|---|---|---|---|
| | Quantity | Value | Quantity | Value |
| S. Korea | 124.0 | 799 | 83.0 | 573 |
| N. Korea | 5.0 | 13 | — | — |
| Hong Kong | 1.0 | 6 | — | — |
| Philippines | 2.0 | 4 | 0.4 | 2 |
| Canada | 71.0 | 240 | 183.0 | 751 |
| U.S.A. | 11.0 | 41 | 9.0 | 39 |
| Chile[1] | 119.0 | 212 | 430.0 | 783 |
| S. Africa | 0.5 | 3 | — | — |
| Australia | 558.0 | 2,582 | 583.0 | 3,743 |
| Taiwan | — | — | 0.4 | 1 |
| Total | 891.5 | 3,900 | 1,288.8 | 5,892 |

[1]True abalone does not occur off Chile. However, a similar species, *Concholepas concholepas*, called "locos" by Chilean fishermen, is exported to Japan and marked as abalone.
Source: Regional Fisheries Attache, Tokyo.

According to the NMFS Office of International Fisheries, in 1975, a highly successful abalone farming experiment was conducted in waters off Jogashima, an island near Miura in Kanagawa Prefecture (Fig. 1). In this experiment some 100,000 abalone spat were planted on man-made iron reefs, and then submerged to depths of from 5 to 7 meters. Resulting harvests yielded approximately 25 abalone per square meter, an astonishing rate when compared against the average yields previously recorded in the same region of from 0.3 to 0.5 abalone per square meter. The abalone produced in this experiment averaged 14 centimeters in length and 405 grams in weight, a product equal in size and weight to natural abalone. (Source: IFR-77/55.)

## Ecuador Shrimp Industry Sets New Export Records

The Ecuador shrimp industry set new records in 1976. Ecuadorian companies exported a total of 4,338 metric tons (t) of shrimp tails, a 15 percent increase over the 3,784 t exported in 1975. The previous record year was 1969 when 4,082 t were exported. Shrimp exports account for over 50 percent of the value of Ecuador's fishery exports.

Exports for the first 2 months of 1977 were about 20 percent ahead of the same period in 1976. Heavy rains are expected to result in continued good catches, especially of the small "titi" species (*Xiphopenaeus riveti*), and 1977 shrimp exports could set a new record. Rumors of an Ecuadorian ban on shrimp exports due to poor catches have proven incorrect.

Of the total Ecuadorian shrimp catch, an estimated 90 percent is exported. Almost all Ecuadorian shrimp exports are shipped to the United States. U.S. import statistics indicate that the 4,243 t of shrimp imported in 1976 were worth $25.6 million (Table 1). A total of 18 Ecuadorian companies exported shrimp in 1976. About 70 percent of all shrimp shipments were exported by the firms listed in Table 2.

**Table 1.—Ecuadorian shrimp exports to the United States, 1974-76.**

| Year | Quantity (t) | Value (U.S. $1,000) |
|---|---|---|
| 1974 | 2,817 | 11,480 |
| 1975 | 3,655 | 17,382 |
| 1976 | 4,243 | 25,627 |

Source: U.S. Department of Commerce, Bureau of the Census.

**Table 2.—Ecuador's major shrimp exporting companies, 1976.**

| Company | Quantity[1] |
|---|---|
| IPESA | 858.4 |
| ENACA | 589.7 |
| Empacadora Shayne | 572.6 |
| COPESA | 415.3 |
| FRIMAR | 288.0 |
| FRIGORO | 266.3 |
| Total | 2,990.3 |

[1]Tails; metric tons.
Source: U.S. Consulate General, Guayaquil.

Increased shrimp exports are partly due to aquaculture projects in the southern Ecuadorian province of el Oro. Pond culture of *Penaeus vannamei*, and to a lesser extent of *P. stylirostris*, accounted for the production of 600 t of tails in 1975. Estimates for 1976 indicate that the production of tails from pond culture increased to about 700 t and Ecuadorian officials believe that this production will expand significantly in the next 2 years. (Source: U.S. Consulate General, Guyaquil; IFR-77/64.)

## *Japanese Fisheries Developments Told*

According to reports from the Regional Fisheries Attache, Tokyo, Japanese exports of fishery products were worth $598.7 million in 1976 according to preliminary customs statistics released in Tokyo, 21 January 1977. While 1976 exports were 34 percent larger than in 1975, fishery imports were up 49 percent from 1975. Japanese fishery imports exceeded exports, as they have every year since 1972, and were worth $1,781.4 million. Japanese exports of fishery products to the member nations of the European Economic Community doubled in 1976, to $104 million, and exports to the United States also increased by 54 percent to $177.8 million. At the same time, Japanese imports of fishery products, including large amounts of shrimp from Southeast Asian nations,

were worth $1,110.2 million in 1976, an increase of 46 percent from 1975. Imports from the United States, particularly of tanner crab, salmon, and herring roe, increased 31 percent to $21 million.

Japan's 1975 catch from its coastal and offshore fisheries increased, but did not offset a decline of 530,000 metric tons (t) in its high-seas fisheries catch. The total national catch for 1975 was 10,520,000 t, a decrease of 280,000 t from 1974.

The Soviet Ministry of Fisheries proposed to share information and swap species/area quotas with Japan's consolidated whaling company, Nippon Kyodo Hogei, according to Japanese press reports. The Soviet Union and Japan are the only nations now whaling in the Antarctic and a growing spirit of cooperation between the two which might result in joint venture was reported by the article. Japanese officials denied the report.

The Japanese Government and the country's fishing industry are seeking to learn the Soviet Union's intentions following the December 1976 declaration of a 200-mile fishery zone which the Soviets began enforcing 1 March 1977. Agriculture and Forestry Minister Zenko Suzuki, a leading fisheries politician before his appointment to the Fukuda Cabinet in December 1976, chose to send Akira Matsuura, Director of the Marine Fisheries Department of the Japanese Fisheries Agency, to Moscow. In Moscow, Director Matsuura met with his counterpart, Director Stepanov of the Soviet Fisheries Ministry, and, accompanied by the Japanese Ambassador to the Soviet Union, Shigemitsu, also met with Soviet Fisheries Minister A.A. Ishkov. Minister Ishkov recommended an early visit to Moscow by Minister Suzuki. Bilateral fishery talks on salmon, herring, crab, and other resources of the Sea of Japan and the northwestern Pacific, began 15 March in Tokyo.

Meanwhile, the largest private Japanese consolidated fishing corporation, Taiyo Gyogyo, sent its new president, Tojiro Nakabe, to Moscow. The Taiyo Company and the Soviet Ministry of Fisheries are reported to be discussing the purchase of $33.7 million of processing and refrigerating equipment suitable for use in the seafood industry in the Soviet Far East. The Soviet Union would pay for such equipment through sales of finished products to Taiyo.

The details of the discussions were not made public, but public controversy has resulted from the Soviet talks with Taiyo since coastal fishermen of northern Japan fear that giant Taiyo Company will strengthen the fishing industry of the Soviet Union at their expense. If the Soviet industry is able to catch and process larger amounts of fish, decreased quotas for Japanese fishermen fishing on the same grounds may result.

The Japan Trawler Association planned to reduce the size of the Japanese fishing fleet in the eastern Bering Sea in 1977. Preliminary plans would decrease catcherboats from 95 to 86 and independent stern trawlers from 17 to 15. The number of motherships would not change from the 5 vessels which were licensed in 1976. The decrease in vessels implies a reduction of catch by 97,000 t. Further reductions could be accomplished by decreasing the quotas of the remaining catcherboats and independent stern trawlers.

In 1977, the U.S. allocated Japan 836,400 t of pollock in the northeast Pacific, including 792,300 t in the Bering Sea and Aleutian area, and 44,100 t in the Gulf of Alaska. According to Japanese reports, Japanese fishermen caught 1,000,000 t of pollock in these areas in 1976 and 1,055,819 t in 1975. (Source: IFR-77/50.)

## The Fisheries of Burundi

Commercial, artisanal, and "traditional" fishermen of Burundi in East Africa fish mostly in Lake Tanganyika, the country's only important fishing area.

The severe decrease in the catch by the artisanal and traditional fishermen in 1972, 1973, and 1974 (Table 1) was due to major ethnic strife, prolonged civil disturbances, and the consequent fear which prevailed, especially during 1972 and 1973. The return to normalcy in 1975 allowed for a more intensive effort by both the artisanal and traditional fishermen. For example, although the number of vessels owned by commercial fishermen increased from 18 to 21, their catch in 1975 was 1 percent below that of the previous year, and represented only 40 percent of the total catch compared to 56 percent in 1974. In contrast, the 389 artisanal fishing vessels (a 93 percent increase in the number of vessels since 1974) permitted the small fishermen to increase their catch by 52 percent. As a result, they took 31 percent of the total catch in 1975 compared to 28 percent in 1974. Similarly, the traditional fishing fleet, which was augmented by 92 percent to 784 vessels since 1974, increased its catch by 156 percent, and represented 29 percent of the total catch compared to 16 percent in 1974.

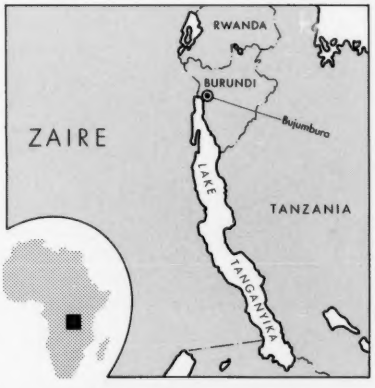



**Table 1.—Burundi fisheries catch, 1971-75, in metric tons.**

| Year | Commercial fishery | Artisanal fishery | Traditional fishery | Total |
|---|---|---|---|---|
| 1971 | 6,053 | 4,876 | 5,966 | 16,895 |
| 1972 | 4,327 | 1,270 | 1,846 | 7,433 |
| 1973 | 5,620 | 1,336 | 1,568 | 8,524 |
| 1974 | 6,211 | 3,127 | 1,765 | 11,103 |
| 1975 | 6,144 | 4,746 | 4,526 | [1]15,416 |

[1]The total fisheries catch reported to FAO was 14,531 metric tons.
Source: Burundi Fisheries Service.

The fisheries catch in 1975 was valued at about $3.0 million compared to $2.2 million in 1974 (Table 2). The value may reach $4 million in the future because a recent World Bank study indicates that as much as 20,000 to 25,000 tons of fish could be caught in Lake Tanganyika each year.

**Table 2.—The value of Burundi's fisheries catch, 1971-75, in U.S.$1,000.**

| Year | Commercial fishery | Artisanal fishery | Traditional fishery | Total |
|---|---|---|---|---|
| 1971 | 697 | 400 | 389 | 1,486 |
| 1972 | 697 | 114 | 34 | 845 |
| 1973 | 1,016 | ——140[1]—— | | 1,156 |
| 1974 | 1,346 | 571 | 317 | 2,234 |
| 1975 | 1,625 | 660 | 762 | 3,047 |

[1]The value of the artisanal and traditional catch combined was $140,000.
Source: Burundi Fisheries Service.

**Table 3.—Burundi fisheries catch, by species, 1975, in metric tons.**

| Fishery | Species | | | Total |
|---|---|---|---|---|
| | Ndagala | Predators | Others | |
| Commercial | 4,038 | 2,106 | — | 6,144 |
| Small-scale | 4,599 | 130 | 17 | 4,746 |
| Traditional | 3,579 | 12 | 935 | 4,526 |
| Total | 12,216 | 2,248 | 952 | 15,416 |

Source: Burundi Fisheries Service.

The artisanal and traditional fishermen generally restrict themselves to the catching of small fish, the ndagala[1] and similar species. On the other hand, the commercial fishermen have a virtual monopoly on predator fishes or "voraces." Table 3 indicates the 1975 catch by species.

The Burundi Fisheries Service is a part of the Department of Water Resources and Forestry which is within the Ministry of Agriculture, Livestock, and Rural Development. The principal responsibilities of the Service are the enforcement of laws and regulations applicable to the fishing industry, the coordination and direction of research, and the collection of data of concern to the industry.

The Société Régionale de Développement des Pêches (Regional Fisheries Development Company) is responsible for fisheries development and is also under the direction of the Ministry of Agriculture. It functions, however, as an autonomous agency and is empowered to undertake commercial, industrial, and financial activities. A general manager runs day-to-day operations.

As a result of fisheries research conducted by the World Bank on Lake Tanganyika, the International Development Association (IDA) granted US$6.0 million to Burundi to promote small-scale fishing on the lake. Because the financing has been granted by the IDA, some of the equipment to be supplied for the project, which will span 5 years, might offer trade opportunities for U.S. exporters. These goods and the estimated purchase values are: 1) Outboard motors, at US$170,000; 2) fishing nets at US$200,000; 3) lamps and lamp parts at US$200,000; and 4) processing plant equipment at US$125,000. (Source: U.S. Embassy, Bujumbura; IFR-77/70.)

[1]"Ndagala" or "dagaa" are small, sardine-like, freshwater fish and include the species *Limnothrissa miodon* and *Stolothrissa tanganicae*.

## EC NEGOTIATES FISHERY CLAIMS

The European Community (EC) fisheries negotiations with nonmember countries fall into three general categories depending on the interests in each others fisheries.

The USSR, Poland, East Germany, Finland, Sweden, Spain, Bulgaria, and Romania all belong to the group that have appreciable fishing interests in EC waters while EC fishermen have minimal interests in their waters. (Romania and Bulgaria have already been excluded due to their relatively recent arrival in the North Sea fisheries and also because of lack of EC interest in their waters, the Black Sea.)

The second group includes Norway, Iceland, and the Faeroe Islands which do have fishing areas of interest to the EC. These countries also have a traditional interest in EC waters. The EC is therefore attempting to achieve a flexible agreement whereby, for example, Norwegian fishermen will be permitted to catch the same amount of fish in the EC zone as EC fishermen will catch in the Norwegian zone. This approach has been unsuccessfully tried in negotiations with Iceland. (Iceland is primarily interested in EC herring and, anticipating an EC herring ban in 1977, the Icelanders are reluctant to permit EC fishermen into Iceland's waters to catch their valuable cod.)

The third category includes the United States and Canada in whose waters some EC members want to fish. Neither Canadian nor U.S. fishermen are interested in EC waters. The result of the negotiations with third countries will depend on quotas given member states. The resulting agreements will also necessitate a large high-seas patrol fleet. While the EC more or less agrees about negotiations with third nations and about control of third-country fishermen, disagreements exist with regard to conservation measures and catch quotas for member states. Denmark is caught in the middle in both of the above disagreements.

Danish fishermen are troubled by prospects for herring, sprat, and blue whiting fisheries. It is primarily the large, traditional Danish reduction fishery in the North Sea which was threatened by the conservation measures under discussion. In particular, the Danes found most troublesome the proposal to ban fishing for the North Sea herring. Denmark cannot accept a total ban on herring without some allowance being made for a herring by-catch in the Danish reduction fishery. (In 1975 Denmark landed 174,000 tons of herring as by-catch.) Denmark also demanded that the herring fishery in the Skagerrak not be included in any herring ban zone (although the Skagerrak is contiguous to the North Sea).

Another area of contention is along the eastern coast of Scotland where the Danish fleets catch sprat (300,000 tons in 1975). The UK proposed that this area be closed to reduction fishing because they claim the sprat fishery is destroying most of the valuable juvenile groundfish stocks which will in a few years be caught for human consumption. Denmark also demanded that blue whiting not be subjected to conservation measures because this stock is largely unexploited and could supplement the Danish reduction industry.

Finally, the major problem to be resolved concerns Irish and Scottish fishermen's demands that they have an exclusive 50-mile zone off their coasts. They have not been willing to accept the 12-mile exclusive zone the EC has proposed. Both Scotland and Ireland

argue that their fisheries are underdeveloped and they want to have the opportunity to exploit more fully their own coastal resources to build up their fishing industries. Denmark has proposed that Ireland and Scotland have zones reserved for catching fish using methods traditionally used by coastal fishermen. (This implies the continuation of the present, semiartisanal fishing methods which produce smaller quantities of fish per unit of effort when compared with the more technically developed fleets.)

A later press release reported that the Danes had reached an agreement with that segment of the UK fleet which had been forced out of Iceland's waters to supply reduction fish (mackerel and herring) to Danish fish meal plants. These vessels will be allowed to fish inside the 12-mile limit and should fill a critical gap in Denmark's fish supply, provided the UK fishery management officials do not object. (Source: U.S. Embassy, Copenhagen; IFR-77/35.)

## IRAQ MODERNIZES ITS FISHING INDUSTRY

The Iraqi State Fishing Company, established in 1972, has jurisdiction over marine and inland fisheries. It is responsible not only for developing the catch of fish, but also for its distribution. As a result, it owns cold stores and refrigerator trucks and is building its own marketing system.

The Company owns six 150-ton trawlers and six steel shrimp vessels, all recently acquired. It is also opening a fishermen's training center. Until now the fish harvesting industry depended entirely on traditional craft and methods.

Marine fish is cheap in Iraq and, because it is considered an essential food, its prices are controlled. To help keep prices down, Iraq imports 20,000 tons of fish a year. Freshwater fish is more expensive. Elaborate plans are being drawn up for the establishment of inland fish farms. There are plans for oceanographic and marine biology studies and for setting up a Center for Arabian Gulf Studies at Basrah. The possibility of training experts in these fields in Ireland was raised on a number of occasions by the Iraqis.

The State Fishing Company has recently opened its own net factory near its new fish-processing plant on the Shatt-El-Arab, the Iraqi coast on the Persian Gulf.

The length of Iraqi coastline is only 48 km, but the country has sovereignty over a few islands in the Arabian Gulf, where a large new floating port has been created to service tankers of up to 265,000 tons. The number of fishermen, just over 1,000 in 1972, is expected to double by the end of the decade. Fishermen in the State Fishing Company trawlers are paid a basic wage.

Although the fishery catch has declined, the 1980 catch is expected to reach 80,000 t from the Gulf and the Indian Ocean (to which some of Iraq's new trawlers will be directed) and 120,000 t from the inland waters, where it is proposed to create 260 hectares of fish farms.

The marine fish caught are chiefly pelagic, but includes two species of shrimp. The per capita fish consumption in Iraq (population about 12 million), 2.2 kg in 1972, has been rising rapidly and is expected to reach 9 kg in 1977, and 15 kg for a population of 13.2 million in 1980. By 1980, the State Company hopes to have 19 smaller and 15 refrigerated trawlers as well as traditional craft. (Source: IFR-77/24.)

According to the NMFS Office of International Fisheries, under the 1969 fisheries cooperation agreement between Iraq and the Soviet Union, the formation of a joint fishing company, named Ar-Rafidayn Fish Co., Limited, was announced on 1 July 1975. (For details see International Fisheries Report 75-165.) No further information on this company is available. In 1976, however, the Soviet Union delivered two 340-ton trawlers, ordered by the State Fishing Company at a reported cost of US$14.6 million[1]. Deliveries of several smaller vessels or contracts to purchase fishing vessels from the Soviet Union were also reported.

The projected catch increases to 80,000 t from the Gulf and the Indian Ocean and 120,000 t from inland waters by 1980, appear overly optimistic. In 1975, the Iraqi marine catch was 7,200 t and the freshwater catch was 14,632 t. Moreover, Iraq's total fisheries catch has been declining since 1972. According to the FAO's "Yearbook of Fishery Statistics," Iraq's total fish catch has been: 1971, 27,200 t; 1972, 32,000 t; 1973, 27,700 t; 1974, 24,246 t; and 1975, 21,832 t.

[1]The cost of the vessels in Iraqi currency is 4.25 million divars. This figure converted directly into dollars yields $14.6 million. If converted first to rubles then to dollars, it becomes about $2.5 million, a more believable figure.

## *U.S.-Russian Claims Board Notes Progress*

The U.S.-USSR Fisheries Claims Board was established on 21 February 1973 and began to function officially in early 1974. The Board was established to facilitate the settlement of claims advanced by a national of one country against a national of the other country as a result of damage to fishing vessels or gear, or loss of or damage to the catch. The agreement initially provided for the consideration of claims arising from loss or damage sustained in the northeastern Pacific Ocean, including the Bering Sea. It was amended on 21 June 1973 to include consideration of claims arising from incidents in the western Atlantic Ocean.

Each Government appoints two members to the Board who act as independent judges in settling claims. Initially, the Board examines evidence submitted by fishermen of either country and then determines whether the evidence is sufficient to recommend a settlement as to who is responsible for the damages incurred. Cases in which the Board recommends payment by the Soviet Government are reviewed by that Government before payment is authorized. The recommendations of the Board are not binding on any party and a claimant may ask the Board to reconsider its recommendation.

In its 3 years of existence, the Board has examined 72 allegations of loss or damage to American fishing vessels or

gear by Soviet vessels. The Board made recommendations in 53 of these cases, 31 of which were favorable to U.S. claimants (Table 1). Settlements totaling $205,910 have been made.

**Table 1.—Claims board favorable and unfavorable recommendations to U.S. claimants and active cases at year's end, 1974-76.**

| Year | Favorable | Unfavorable | Active cases |
|---|---|---|---|
| 1974 | 5 | 1 | 19 |
| 1975 | 10 | 4 | 33 |
| 1976 | 16 | 17 | 5 |

In 14 cases, the Board found that four claims were deficient in the amount of evidence required to establish the responsibility of Soviet vessels, three were submitted beyond the filing period established by the Agreement, five were filed after the period which the Board may consider, and two were terminated at the claimants' requests. Five cases remain under active consideration by the Board in 1977 (Table 1). (Source: Report for the Year 1976 of the U.S.-USSR Fisheries Board. IFR-77/42.)

## *Sri Lanka Gets Abu Dhabi Fishery Loan*

The Government of Sri Lanka and the Sheikhdom of Abu Dhabi signed a fisheries assistance agreement in late 1976. Under the agreement, Sri Lanka will receive a low interest loan of $11.4 million from the Abu Dhabi Fund for Economic Development (ADFED). This loan, repayable in 10 years with a 4-year grace period, will be used to add 172 new trawlers to Sri Lanka's fishing fleet, and to purchase additional equipment and spare parts for the existing facilities of the Ceylon Fisheries Corporation.

The 172 new vessels include 150 shrimp trawlers (32 feet long), 20 multipurpose trawlers (38 feet long), and 2 multipurpose trawlers (60 feet long). These trawlers will operate in the Gulf of Mannar and the Palk Straits (see map) using midwater and bottom trawls.

The fisheries development plan financed by the loan will be administered by a special committee set up by the Ministry of Fisheries in Sri Lanka and representatives of the ADFED. (Source: IFR-77/60.)

According to the NMFS Office of International Fisheries, Sri Lanka's 1975 fisheries catch was 129,123 metric tons (t), an increase of 16.6 percent from the 110,700 t caught in 1974. The Sri Lankan fishing fleet consisted of 6,293 mechanized and about 17,000 nonmechanized fishing vessels in 1973, the last year for which the fishing fleet statistics are available.

In recent years, Sri Lanka has received development assistance for its fishing industry from the Asian Development Bank, Japan, and the People's Republic of China, as well as from Abu Dhabi. For example, in 1962 Japan assisted Sri Lanka in establishing a fisheries training center at Negombo, close to a major Sri Lankan fishing area. This was followed in 1974 by additional assistance to help establish other fisheries training centers. In addition to providing funds for the construction and purchase of center facilities and equipment, Japan also provided training staff and a research vessel valued at US$800,000. In 1974, Japan and Sri Lanka also agreed to undertake a joint survey of Sri Lanka's tuna resources to determine the economic feasibility of initiating a joint tuna fishing venture.

Sri Lanka's 1976 exports of tuna, shrimp, and lobster to the United States were 728 t, worth about $2.3 million. Almost 45 percent of these imports were frozen skipjack and yellowfin tuna. Frozen, peeled shrimp accounted for 32 percent (Table 1).

**Table 1.—U.S. fishery product imports from Sri Lanka, 1976, in metric tons and US$1,000.**

| Product | Quantity | Value |
|---|---|---|
| Yellowfin tuna, frozen | 5 | 4 |
| Skipjack, frozen | 308 | 242 |
| Other fish, frozen | 2 | [1] |
| Rock lobster tails, frozen | 76 | 257 |
| Other lobster, frozen | 12 | 683 |
| Shrimp, shell-on | 87 | 105 |
| Shrimp, peeled | 234 | 451 |
| Shrimp, other | 4 | 25 |
| Total | 728 | 2,317 |

[1]Less than $500.
Source: NMFS Data Management and Statistics Division (F51).

## Erratum

The butterfish referred to on page 30 of the April issue (39:4) of *Marine Fisheries Review* is *Peprilus triacanthus*, not *Psenopsis anomala*, which is a Pacific species.

## *Japan Tries Solar Heat System for Aquaculture*

A new solar heating system has been designed in Numazu, Japan, to help stimulate the development of aquaculture in cold regions by allowing aquaculturists to control the temperature in ponds. Raising water temperatures can increase growth of some fish species and solar power is cheaper than conventional fuels.

The Japanese heating system will cost approximately $17,500 in initial investment, but start-up costs are expected to be offset in 2 years by anticipated savings in normal fuel expenditures required for operation. Conventional fuel costs would average $35 per day to raise the temperature of 100 tons of water from 16°C to 25°C. For an average 8-month period, fuel costs would amount to about $8,500. The solar heating system, which consists of a heat-absorbing panel, a hot-water circulator, and a water tank, is capable of raising water temperatures to 80 degrees centigrade on cloudless days even in the winter. The system can also be used to aid the growth of organic feeds needed in the rearing of fish.

A pilot project of similar design has been used in culturing tropical fish. The engineer responsible for the system intends to construct a model plant using the system in Mishima, Shizuoka, Japan. (Source: IFR-77/47.)

## LORAN-C Operates on Pacific Coast

West Coast mariners have had a helping hand to guide them in navigating the waters of the Pacific from the Canadian border to Baja California since 25 April when the West Coast chain of the LORAN-C radio navigation system became operational.

LORAN (for Long Range Navigation) is an electronic system using shore-based radio transmitters and shipboard receivers to allow ships to pinpoint their position at sea. The LORAN-C system provides 95 percent assurance that a vessel can fix its position to an accuracy of 0.25 nautical mile. It will replace the less accurate LORAN-A system developed during World War II.

The Secretary of Transportation plans to provide LORAN-C coverage for all mariners throughout the U.S. Coastal Confluence Zone and Alaska. The west coast chain is the first of three Pacific area chains which were scheduled to cover the Pacific Coast from Alaska to Baja by midsummer.

Four newly constructed stations in Fallon, Nev.; George, Wash.; Middletown, Calif.; and Searchlight, Nev., make up the West Coast chain which is the first such chain constructed specifically for civilian maritime users.

The stations began transmitting before 25 April for calibration purposes and commenced service to west coast mariners at 1600 hours Pacific Daylight time on 25 April. Charts for use with the system have been printed and are available from the National Oceanic and Atmospheric Administration's National Ocean Survey.

Other chains in the LORAN-C system were scheduled to become operational as follows: Canadian West Coast—May 1977; Gulf of Alaska expansion—June 1977; Gulf of Mexico (Southeast U.S.)—July 1978; East Coast reconfiguration (Northeast U.S.)—July 1978; Great Lakes expansion—February 1980.

Secretary Adams' decision to implement LORAN-C was based on the results of a study of navigation systems by the Coast Guard. Four radio navigation systems were considered: LORAN-A, LORAN-C, differential Omega, and Decca. Factors considered in the study included capability to meet the technical requirement and costs including system installation, operating expenses, present investments, and availability and cost of user equipment. Navigational requirements of the various user groups, including merchant mariners, commercial fishermen, and the scientific community, were also considered.

## Oysters Transplanted To Corpus Christi Bay

About 16 sacks of live oysters were transplanted to formerly productive reefs in Corpus Christi Bay from South Bay near Port Isabel earlier this year, the Texas Parks and Wildlife Department reports. Over the past several years, producing reefs have almost disappeared from the Corpus Christi Bay area, according to Tom Moore, Texas Parks and Wildlife Department coastal fisheries director. While different factors may have contributed to the decline of live reefs in Corpus Christi Bay, disease may well have played a major role, Moore said.

South Bay oysters were selected for the project because they are disease-free, are of a hardy strain and have a wide tolerance to salinity variation.

"These oysters taken from South Bay will hopefully form the seed broodstock in Corpus Christi Bay," said Moore.

## *Rock Shrimp May Aid Commercial Trawlers*

Rock shrimp, an offshore species of shellfish, may provide supplemental catches for South Carolina commercial shrimpers faced this year with a much reduced population of white shrimp, an industry mainstay. A survey of rock shrimp by the South Carolina Wildlife and Marine Resources Department has located possible commercial quantities of rock shrimp from 40 to 65 miles offshore. Although most of the sampling was done with a small try net, one 30-minute drag with twin 80-foot shrimp nets produced 92 pounds of rock shrimp. The survey was conducted aboard the Marine Resources Division research vessel, *Atlantic Sun*, a 70-foot shrimp trawler.

Of the 42 sites sampled only two failed to produce any rock shrimp. Using the try net, researchers caught an average of one shrimp per minute which is indicative of possible commercial quantities of shrimp. The offshore survey area extended from St. Catherine's Island in Georgia to Charleston Harbor, all within 7 hours running time of Port Royal Sound. Information on where rock shrimp were caught, how many were caught, and the methods and gear used has been made available on request to anyone in the industry.

Biologists stressed that rock shrimp fishing would not replace the normal catches of inshore shrimp species, but would at best supplement these catches during the offseason.

## AOAC Plans 91st Annual Meeting

The 91st Annual Meeting of the Association of Official Analytical Chemists (AOAC) is scheduled for 17-20 October 1977, reports Luther G. Ensminger, Executive Secretary. It will be held at the Marriott Hotel, Twin Bridges, Washington, DC 20001.

Papers and symposia will be presented on methods of analysis for materials and products important to the environment, health, and agriculture (ie., drugs, pesticides, food, beverages, food additives, cosmetics, feed, fertilizers, microbiological contamination of foods, forensic materials, environmental pollutants, and related subjects.) For further information, contact L.G. Ensminger, Executive Secretary, AOAC, Box 540, Benjamin Franklin Station, Washington, DC 20044.

# New NMFS Scientific Reports Published

The publications listed below may be obtained from either the Superintendent of Documents (address given at end of title paragraph on affected publications) or from D825, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235. Writing to the agency prior to ordering is advisable to determine availability and price, where appropriate (prices may change and prepayment is required).

NOAA Technical Report NMFS SSRF-705. Uzmann, Joseph R., Richard A. Cooper, and Kenneth J. Pecci. **"Migration and dispersion of tagged American lobsters, *Homarus americanus*, on the southern New England continental shelf."** January 1977. 92 p.

ABSTRACT

An apparently contiguous stock of American lobsters, *Homarus americanus*, is concentrated along the outer continental shelf margin and slope from Corsair Canyon westward and southward to the region of Baltimore Canyon. Between April 1968 and May 1971 we captured, tagged, and released a total of 7,326 lobsters at 52 localities between Corsair Canyon and Baltimore Canyon. As of December 1972, 945 recaptures (12.9% recovery) had been reported, providing a basis for interpretation of seasonal and long-term movements, as well as measurements of growth rate and moult frequency. A classification scheme is developed and applied to distinguish between apparently directed seasonal movements (migrations), localized movements of less than 10 nautical miles (18.5 km), and long-period (120 days) dispersions of 10 miles or more. This last category includes point to point tracks that cannot be objectively resolved in terms of directionality and may represent random dispersal, a summation of seasonally directed tracks, or both.

We conclude from the track analyses that at least 20% of the offshore lobsters annually engage in directed shoalward migrations in spring and summer with return to the shelf margin and slope in fall and winter. This conclusion is reinforced by independent analysis of the time/depth/temperature associations of tagged lobsters at recapture which, of itself, suggests that an even larger proportion of the offshore lobsters annually effect directed migrations in response to seasonal temperature variations.

NOAA Technical Report NMFS SSRF-704. Anderson, William D., Jr., James K. Dias, Robert K. Dias, David M. Cupka, and Norman A. Chamberlain. **"The macrofauna of the surf zone off Folly Beach, South Carolina."** January 1977. 23 p.

ABSTRACT

A seining survey of the macrofauna of the surf zone at Folly Beach, Charleston County, S.C., was conducted from October 1969 to October 1971. Eighty-seven collections were made in the surf and associated tidal pool resulting in the capture of 512 specimens of swimming invertebrates representing at least 17 species and 5,095 specimens of bony fishes representing 41 species.

The data obtained are analyzed on seasonal and yearly bases for total weights and numbers of species and specimens. Species are ranked as to importance; and prediction equations for monthly average number of specimens per collection in the surf, based on environmental variables, are developed. Length-frequency data and other aspects of the biology of selected species are presented. Length-length and length-weight relationships are given for certain species. Recommendations for the improvement of the methodology for similar surveys are made.

NOAA Technical Report NMFS SSRF-706. Matthews, Frances D., David M. Damkaer, Leslie W. Knapp, and Bruce B. Collette. **"Food of western North Atlantic tunas (*Thunnus*) and lancetfishes (*Alepisaurus*)."** January 1977. 19 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

ABSTRACT

Stomach contents of 395 longline-caught specimens of *Thunnus* (281 *T. albacares*, 52 *T. t. thynnus*, 48 *T. alalunga*, 14 *T. obesus*) and 89 *Alepisaurus* were examined. About 45% of the tuna's food, by volume, was composed of fishes, 35% of cephalopods, 15% of crustaceans, and 5% of miscellaneous items. Fishes eaten by tunas ranged in length 9-360 mm SL ($\bar{x}$ 65 mm) and represented a minimum of 88 genera in 58 families. Fishes eaten by *Alepisaurus* were 8-846 mm SL ($\bar{x}$ 98 mm) and represented 40 genera in 34 families. Most forage fishes were immature forms of midwater and shore fishes, many of which are associates of the pelagic *Sargassum* community. Ten of the most frequently occurring families in *Thunnus* and *Alepisaurus* stomachs were Bramidae, Alepisauridae, Balistidae, Paralepididae, Scombridae, Sternoptychidae, Carangidae, Tetraodontidae, Gempylidae, and Syngnathidae.

Cephalopods were the most frequently occurring (80-90%) invertebrate group in the tuna stomachs, particularly the squid family Ommastrephidae. Crustaceans followed the cephalopods in frequency of occurrence (30-80% depending on tuna species). Larval decapods and hyperiid amphipods were the principal groups of crustaceans. In *Alepisaurus* stomachs, cephalopods occurred with 50% frequency, usually octopods and soft-bodied squids, families Cranchiidae, Histioteuthidae, and Bathyteuthidae. Crustaceans were present in 75% of *Alepisaurus* stomachs. Fewer decapod larvae were found than in the tunas, while amphipods were found

more frequently. Pelagic polychaetes (Family Alciopidae), not found in any tunas, occurred in 38% of *Alepisaurus* specimens.

Differences in the relative importance of particular forage categories in the diet of different species of *Thunnus* and between the diets of *Thunnus* and *Alepisaurus* suggest interspecific differences in feeding, either anatomical (i.e., relative predatory ability) or behavioral, particularly the relative swimming speeds and feeding depths of different predators. The small-mouthed tunas consumed generally smaller prey fishes ($\bar{x}$ 98 mm SL) than did the large-mouthed lancetfishes ($\bar{x}$ 240 mm SL). Smaller sized yellowfin tunas generally consumed smaller prey than did larger yellowfins. Differences in swimming ability between tunas and *Alepisaurus* were reflected in the larger number of swift-moving muscular squids eaten by the tunas. Composition of the forage indicated that *T. albacares* fed at shallower depths than the other species of *Thunnus* and that *Alepisaurus* fed at greater depths than any of the tunas.

NOAA Technical Report NMFS SSRF-707. Temple, Robert F., David L. Harrington, and John A. Martin. **"Monthly temperature and salinity measurements of continental shelf waters of the northwestern Gulf of Mexico, 1963-65."** February 1977. 26 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.


ABSTRACT

Temperature and salinity observations made monthly from January 1963 to December 1965 at 48 stations in the northwestern Gulf of Mexico are presented. Off the coasts of Louisiana and Texas monthly average temperatures of surface and bottom waters at station depths of 7, 14, 28, 46, and 73 m exhibited seasonal trends that were similar over a 3-yr period. Monthly average temperatures of surface and bottom waters were generally similar at station depths of 7 and 14 m, but differences were noted at station depths of 28, 46, and 73 m and increased with depth. Maximum average temperatures of bottom waters at station depths generally greater than 14 m occurred after surface temperatures


## A New NOAA-MARAD Report: Hydrocarbons in the Ocean

The first comprehensive survey of existing hydrocarbons in the world's oceans shows small quantities of these compounds everywhere, with faint trails of higher concentrations along major routes followed by oil tankers.

The study by the National Oceanic and Atmospheric Administration (NOAA), the U.S. Maritime Administration (MARAD), and Exxon Corporation measured the amounts of hydrocarbons currently present in ocean waters. This knowledge of present-day distributions of hydrocarbons, which can come from a variety of sources besides petroleum, provides a baseline against which future environmental changes can be detected and evaluated.

A final report of the study has now been published by MARAD and NOAA's Marine Ecosystems Analysis Program. Both MARAD and NOAA are agencies of the Department of Commerce. In the report Edward P. Myers of the MESA program, and Charles G. Gunnerson, Environmental Engineering Advisor for NOAA's Environmental Research Laboratories, conclude that though hydrocarbon levels vary greatly from place to place, most measurements in the upper water levels are in the range of 1-10 parts per billion. In deeper ocean waters, hydrocarbon levels are lower, often less than 1 part per billion. Coastal and harbor waters, and open ocean waters frequented by tanker traffic, have higher concentrations of hydrocarbons than does the open ocean off major routes.

For the study, water samples were collected from Exxon tankers travelling on such routes as New York to the Gulf Mexico and the Persian Gulf to Europe, and from research vessels associated with the National Science Foundation in the Atlantic and Pacific. The researchers also culled hydrocarbon measurements from reports of research conducted by many other scientists.

Some of the samples were analyzed to determine the chemical types and possible origins of hydrocarbons. The researchers found that cycloparaffins were the dominant type everywhere. "Since cycloparaffins have not been reported as being ubiquitous in marine organisms, their presence would tend to suggest a petroleum source," they reported.

The National Academy of Sciences estimates that 6 million metric tons of hydrocarbons enter the sea each year. About 35 percent of this can be attributed to leakage incidental to the marine transportation of petroleum, river runoff adds 26 percent; natural seeps and the atmosphere contribute 10 percent each; nonrefining industrial wastes, urban runoff, and municipal wastes a total of 15 percent; and coastal refineries and offshore oil production, 4 percent. Organisms in the sea also produce hydrocarbons, but of a chemical type different from petroleum.

Myers and Gunnerson point out that experiments on petroleum's effects on marine life usually involve much higher concentrations than they found. But petroleum hydrocarbons at levels near those found at some places in the oceans can affect behavioral traits of certain organisms. The researchers suggest that studies focus on the effects and risks associated with present and possible future levels of hydrocarbons in the oceans.

The hydrocarbon report includes maps showing the locations where water samples were collected and the average hydrocarbon levels in different regions, graphs of relative frequencies of hydrocarbon concentrations along tanker and research ship routes, and profiles of hydrocarbon types at different depths.

The report **Hydrocarbons in the Ocean,** is available from Marine Ecosystems Analysis Program, NOAA, ERL, Boulder, CO 80302.

had passed their maximum and were dropping.

Salinities of surface and bottom waters varied markedly at 7- and 14-m stations, whereas at deeper stations seasonal fluctuations were restricted primarily to surface waters. The magnitude of yearly salinity fluctuations decreased with an increase in distance offshore. The effects of the seasonal freshwater inflow of the Mississippi River and other Louisiana rivers on salinities were clearly apparent in Louisiana and Texas offshore waters, although in the latter case there may have been a 1- or 2-mo lag.

NOAA Technical Report NMFS SSRF-708. Sutherland, Doyle F. **"Catch and catch rates of fishes caught by anglers in the St. Andrew Bay system, Florida, and adjacent coastal waters, 1973."** March 1977. 9 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

ABSTRACT

Anglers were interviewed on four fixed platforms in the St. Andrew Bay system and on charter boats that were fishing in the bay and adjacent coastal waters in 1973. They caught fishes of at least 54 species (not all were identified to species) in 31 families. The majority (58.0%) of the fishes that were caught from fixed platforms consisted of pinfish, *Lagodon rhomboides*, (18.2%); sea catfish, *Arius felis*, (12.2%); spotted seatrout, *Cynoscion nebulosus*, (10.0%); blue runner, *Caranx crysos*, (8.8%); and crevalle jack, *Caranx hippos*, (8.8%). On charter boats, king mackerel, *Scomberomorus cavalla*, comprised the majority of the catches (73.9%).

The average catch rates varied from 0.0 to 10.7 fish/h among anglers on fixed platforms and from 0.0 to 32.0 fish/h among charter boats. The greatest monthly average catch rates on fixed platforms were 2.2 fish/h in October at Deer Point Dam, 1.8 in October at Bailey Bridge, 1.8 in December at Hathaway Bridge, 2.3 in May at West Jetty, and 10.6 in September on charter boats. On the fixed platforms, the highest average catch rate for all months was 1.4 with squid and the lowest was 0.5 with fiddler crabs. Whole round scads and 00-squid spoons were used for bait by virtually all surveyed charter boats.

NOAA Technical Report NMFS SSRF-709. Cook, Steven K., and Keith A. Hausknecht. **"Expendable bathythermograph observations from the NMFS/MARAD Ship of Opportunity Program for 1974."** April 1977. 45 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

ABSTRACT

Results of the fourth year of operation of the NMFS/MARAD Ship of Opportunity Program (SOOP) are presented in the form of vertical distributions of temperature and horizontal distributions of sea surface temperature and salinity. Operational and data management procedures also, are discussed. Included are descriptive analyses of the most dynamic transects showing the Yucatan, Loop, Florida, and Gulf Stream currents and related eddies. Also, characteristics of the cold cell of bottom water on the Atlantic continental shelf are discussed.

NOAA Technical Report NMFS Circular 398. Cavaliere, A.R. **"Marine flora and fauna of the northeastern United States. Higher fungi: *Ascomycetes, Deuteromycetes,* and *Basidiomycetes.*"** March 1977. 49 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

ABSTRACT

This manual provides an illustrated key and alphabetical listing, with brief descriptions, of common genera of higher marine fungi in the classes Ascomycetes, Deuteromycetes (Fungi Imperfecti), and a single member of the Basidiomycetes. A glossary and selected bibliography complement the key. Information on methods of harvesting, incubation, and studying these fungi is also included.

NOAA Technical Report NMFS Circular 399. Coull, Bruce D. **"Marine flora and fauna of the northeastern United States. Copepoda: Harpacticoida."** March 1977. 48 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

ABSTRACT

This manual contains an introduction to the general biology, an illustrated key, an annotated systematic list, a selected bibliography, and an index of the 72 genera and 121 species of marine harpacticoid copepods reported from New Jersey

## *Effects of Marine Pollution Examined*

**The Health of the Oceans,** by Edward D. Goldberg, published by the Unesco Press, is billed as "a preliminary report on the health of the oceans." Goldberg, Professor of Chemistry at Scripps Institution of Oceanography, La Jolla, Calif., lists five major marine pollutants: 1) halogenated hydrocarbons, 2) radioactivity, 3) heavy metals, 4) petroleum hydrocarbons, and 5) litter.

For each pollutant the author reviewed the international scientific literature on quantities being contributed by man and/or by nature, in order to evaluate man's impact on the marine environment. The effects of these pollutants on several marine organisms (and on man, in the case of mercury, etc.) is discussed. In addition the author discusses marine pollution dynamics, pollution prediction and monitoring strategies, and time scales in oceanic and societal processes. The author asks what more needs to be known, compared with what is already known, about the effects of man's pollution on the marine environment, in order to chart long- and short-term strategies for coping with marine pollution problems.

**The Health of the Oceans,** a 172-page, soft-cover book, costs $9.25 and is available from Unesco, 7, Place de Fontenoy, 75700, Paris, France.

to Maine. The key facilitates identification to genus, whereas the annotated systematic list discusses each known species.

NOAA Technical Report NMFS Circular 400. Engett, Mary Ellen, and Lee C. Thorson. **"Fishery publication index, 1965-74."** March 1977. 220 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

ABSTRACT

The following series of fishery publications of the Bureau of Commercial Fisheries (U.S. Fish and Wildlife Service) and the National Marine Fisheries Service (National Oceanic and Atmospheric Administration) in calendar years 1965-74 are listed numerically and indexed by author and subject: Circular, Current Economic Analysis, Current Fishery Statistics, Data Report, Fishery and Oceanography Translations, Fishery Bulletin, Fishery Facts, Fishery Industrial Research, Fishery Leaflet, Fishery Market Development Series, Foreign Fishery Leaflets, NOAA Technical Memorandum NMFS, Separates, Special Scientific Report—Fisheries, Statistical Digest, and Test Kitchen Series.

NOAA Technical Report NMFS Circular 401. McHugh, J. L. **"Fisheries and fishery resources of New York Bight."** March 1977. 50 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

ABSTRACT

The history of total fish and shellfish landings in the two states (New York and New Jersey) that form the landward boundaries of New York Bight is a history of change. Resource after resource has produced maximum landings, then declined. Total landings dropped from about 315,000 metric tons in 1956 to about 23,000 in 1967 and have risen only moderately since that time. The rise and fall of the industrial fisheries, mostly menhaden, was responsible for most of this

## Tropical and Subtropical Fishery Technology and Maritime Bibliography Volumes Published

The first Tropical and Subtropical Fisheries Technological Conference was held 8-10 March 1976 in Corpus Christi, Tex. The proceedings, 37 papers, have been published by Texas A&M University's Center for Marine Resources in two volumes totalling 686 pages. They were compiled by the late Bryant F. Cobb III and Alexandra B. Stockton.

Volume I contains 19 papers, 16 devoted to shrimp. Of the non-shrimp contributions, one outlines the value of technology to the seafood industry, another explains the Food and Agriculture Organization's tropical fish technology cooperative research program. The third reviews the special problems associated with the handling and distribution of fresh fish and crustaceans in the tropics.

The shrimp papers cover the following topics: reproduction, Texas A&M mariculture programs, *Macrobrachium* culture chemical and nutritive composition of shrimp, cholesterol in shrimp tails, bacteriology, biochemistry, and physiology of shrimp, dehydration in stored frozen breaded shrimp, international standardization of shrimp products, trace elements in shrimp harvested from selected areas, PCB's and petroleum hydrocarbons in shrimp, etc.

The 18 papers in Volume II deal with such species as channel catfish, striped mullet, cod, croaker, lobster, and demersal and underutilized Gulf of Mexico fishes. Some of the topics include transfer of lipids through marine food chains, lipid metabolism in channel catfish, flavor problems in fish culture, comparisons of cage raised and wild striped mullet, using insects to supplement channel catfish feed, cold smoking of small mullet, microbial considerations of salt minced cod, fish as an extender in meat products, and underutilized fishery resources of the Gulf of Mexico.

Volume I (TAMU-SG-77-104) contains 416 pages while Volume II runs from page 417 through 686. Copies of the paperbound volumes of the **Proceedings of the First Annual Tropical and Subtropical Fisheries Technological Conference** are available at $20 per set from the Department of Marine Resources Information, Center for Marine Resources, Texas A&M University, College Station, TX 77843.

The **Bibliography of Maritime and Naval History Periodical Articles Published in 1974-75,** by Charles R. Schultz and Pamela A. McNulty, is the fourth volume in a continuing series. Schultz is a University Archivist with the Texas A&M Libraries, Texas A&M University, College Station, Tex., and McNulty is a Reference Librarian with the G. W. Blunt White Library, Mystic Seaport, Mystic, Conn.

This 160-page bibliography primarily lists articles published in 1974-75; however, it also includes articles from 1972 and 1973 that were not accessible when previous volumes were compiled. Items are arranged by subject into 17 categories, covering a wide span of marine literature. It includes useful sections on fisheries, vessels, small craft, maritime law, shipbuilding and allied topics, seaports and coastal areas, etc. The selection of "general" articles contains several references to ocean policy. The volume also has vessel, author, and subject indexes.

Copies of this fourth volume (TAMU-SG-77-601) are available from the Department of Marine Resources Information, Center for Marine Resources, Texas A&M University, College Station, TX 77843 at $4.00 each. Make checks payable to Texas A&M University. Copies of the 1973-74 volume may also be obtained from the Center for Marine Resources. The 1971 and 1972 bibliographies can be purchased from the Mystic Seaport Stores, Inc., Mystic, CT 06355, as long as the supply lasts.

decline, and this has masked trends in the food fisheries.

Altogether about 132 species or groups of species of fishes and invertebrates have been reported as landed in New Jersey or New York since 1880. Fifty of these are discussed and illustrated with figures and tables of landings.

Edible finfish species as a group reached peak landings in 1939 and declined fairly steadily to about one-third that level in the 1970s. Molluscan and crustacean shellfish production reached two peaks, in 1950 and 1966, the second considerably higher than the first. This recovery of shellfish landings in 1966 would not have occurred were it not for the rapid development of the surf clam fishery in the 1950s.

The timing of the decline makes it clear that foreign fishing was not the cause, for foreign fishing probably could not have affected the fisheries of New York Bight before the mid-1960s. Actually, total catches of resources taken only by domestic fishermen have declined more sharply than total domestic catches of species shared with foreign fleets. Foreign fishing is but a symptom of the troubles of the domestic fisheries, some of which are imagined. The ills of the domestic fisheries are economic and sociopolitical, and they will not yield easily to scientific solutions.

## *FISHERIES OF URUGUAY LEAFLET IS PUBLISHED*

A new Foreign Fisheries Leaflet, 77-1, "Fisheries of Uruguay, 1975" has been published by the International Fisheries Analysis Branch and is available for distribution. The 17-page leaflet contains information on catch, the Uruguayan economic situation, fishery resources, grounds, fleet, catch processing, exports, the fisheries administration, research, foreign assistance, investment, and sales opportunities for U.S. companies. A special section in the report details each of Uruguay's major fishing companies. The report was written by Stuart Lippe and Gordon Little of the U.S. Embassy in Montevideo and Dennis Weidner of the Branch's staff.

A copy can be requested from: Services Branch, D825, ESIC, NOAA, WSC4, 6009 Executive Blvd., Rockville, MD 20852. Please enclose two self-addressed labels to facilitate mailing.

## So You Want To Be A Commercial Fisherman

Three years ago *Marine Fisheries Review* devoted its entire June issue (36:6) to a longish manuscript entitled "Some ABC's of Fo'c'sle Living." Written by Sig Jaeger and A. K. Larssen, it was instantly popular, used coast to coast by vocational students and instructors, and was just as instantly out of print, even though many extra copies had been printed. Now, expanded and slightly retitled **The ABC's of Fo'c'sle Living,** it is back in print as a paperback book from Madrona Publishers of Seattle, Wash.

The authors have retained all their homely advice, hard won during their collective 80 years in commercial fishing. They've also added some new material and the publisher has wrapped it up into a fine 103-page volume for those interested in making their living at sea. New and important chapters include "The Tools of the Trade" (fishing gear that might be used), "About Marlinspike Seamanship" (implements for splicing rope and line), "Take Care of the Catch" (practical knowledge about proper fish care), and "Who Started It All" (a look at commercial fisheries development in the Pacific Northwest).

The book also has chapters on fo'c'sle living, clothing and personal gear, pilothouse duty, deck work, the fisherman's responsibilities, the hold, medical rights and personal care, how fishermen get paid, shore leave, a glossary of essential terms, and more.

Larssen, now retired, has fished virtually around the world; his articles appear in fishing publications from Seattle to Bergen, Norway. Jaeger, Manager, North Pacific Fishing Vessel Owner's Association, Seattle, has also fished widely, longlining for halibut and black cod, trolling for albacore, dredging scallops, etc. He has also served as consultant to the Marine Advisory Programs of the University of Washington and the University of Alaska.

"The ABC's . . . " was conceived and written as a guide or text for use in extension courses and vocational classes for would-be commercial fishermen. The new, updated edition fulfills that purpose very well. **The ABC's of Fo'c'sle Living** is available at $3.95 per copy from Madrona Publishers, Inc., 113 Madrona Place East, Seattle, WA 98112.

## A Selected List of Cetacean References

**Whales, Whaling and Whale Research,** subtitled "A Selected Bibliography," contains 1,000 numbered English-language references to books, articles, bibliographic reviews, etc. on cetaceans, cetacean research, whaling, whale products, and related subjects. The volume was compiled by L. R. Magnolia, Manager, Technical Information Center, TRW Defense and Space Systems Group, Redondo Beach, Calif., for the Whaling Museum Society, Long Island, N.Y., for scientists, historians, and laymen.

The citations encompass such topics as natural history, biology, conservation, whale oil substitutes, legal affairs, acoustics, population research, whale attacks, traditional and modern whaling techniques, whaling ships and boats, scrimshaw, etc. The citations, not indexed, are listed alphabetically by the senior author. Most of the references were published during the 30-year period from 1946 to March 1976. The oldest was published originally in 1820.

The soft-cover book has 91 pages and is available for $4.95 (plus 35 cents for shipping) from The Whaling Museum, Cold Spring Harbor, Long Island, NY 11724.

## Stingray Records, Clam Salvage, and a Menhaden Die-Off

. . . . The California Fish and Game Commission's **Fish and Wildlife Award Program has received its first abalone entry** — an 8¼-inch-diameter specimen taken while free-diving in 20 feet of water off Leo Carrillo State Beach by Linda Gray, Los Alamitos. While recognizing outstanding specimens of fish and game, the program provides biological data for maintenance of long-term records . . . .

. . . . **Patt Hawn, Port Aransas, Tex., held three Texas** saltwater fishing records simultaneously with her recently certified records for bluefin tuna and blue marlin, according to the Parks and Wildlife Department. Her third state record was a 325-pound mako shark, although that may be surpassed by a recently entered 388-pounder. Hawn's bluefin tuna weighed 540 pounds and measured 101½ inches long and 66½ inches in girth. It was taken on 23 April with an 80-pound class rod and 80-pound test line. Hawn used identical tackle to take the marlin (560 pounds, 148⅞ inches long, 58½-inch girth) on 20 April some 75 miles off Port Aransas . . . .

. . . . Meanwhile, **Texas has moved to add four ray categories to the State Fish** Records Program. The species considered for records are the southern stingray, Atlantic stingray or stingaree, cownose ray, and spotted eagle ray. Minimum weights listed are: southern ray, 50 pounds; Atlantic ray, 10 pounds; cownose, 40 pounds; and eagle ray, 200 pounds. Rays must be taken on rod and reel only, though the unrestricted division includes the heaviest of the species taken by any legal means (archery, spear, gig, handline, trotline, etc.) other than rod and reel exceeding the weight of existing rod and reel records . . . .

. . . . **Purse seining, used extensively in ocean fishing,** was untried on the Great Lakes until recently. Now, researchers with Michigan's Department of Natural Resources and the Michigan Sea Grant Program are into a 2-year test program to see if the purse seine will become a practical alternative to gill nets for commercial fishing on the Great Lakes. They hope that purse seining will not conflict with sport fishing or other commercial fishing. Advantages cited include the net's selectivity, short time in the water compared with gill nets, adaptability to some existing Great Lakes fishing tugs, and potential use for a wide variety of fish. Primary target fish during the study are lake whitefish, round whitefish (known locally as menominee), yellow perch, and underutilized species like freshwater mullet (sucker) . . . .

. . . . **The Texas Parks and Wildlife Commission, which has been** stocking striped bass in selected bays during the last 2 years, finally recorded its first catch—a 13-incher (stocked when 1½ inches long)—out of Espiritu Santo Bay near Port O'Connor in April. More than 250,000 fingerling-sized stripers have been released in the San Antonio Bay system since 1975 and an additional 200,000 were released by mid-May this year. Stripers are native to Texas and were once found in salt as well as fresh water, the Department notes . . . .

. . . . **To keep an estimated 1 million clams from being dredged,** New Jersey clammers were hired to move them from Tuckerton Creek, the State Division of Fish, Game, and Shell Fisheries reports. Because the area was condemned for shellfish harvesting, clammers received special permits from the Shellfish Control Section to relay the salvaged clams to some 82 leased one-third acre lots in Little Egg Harbor for depuration. Besides saving the clams from the dredge, the operation provided work for clammers after an extremely rough winter. . . .

. . . . **"Oceans '77," the annual joint international conference** and exhibit of the Marine Technology Society and the Institute of Electrical and Electronic Engineers is set for 17, 18, and 19 October in Los Angeles, Calif., at the Bonaventure Hotel. Simon Ramo, general chairman of the conference, said that the meeting will highlight discussion of recent developments in ocean technology and its impact on public policy and education, with a focus on the Pacific Rim. . . .

. . . . **Maryland's mysterious menhaden mortality has again begun and ended** with no real hint as to the causes of the nearly annual die off, the State Fisheries Administration reports. Hundreds of menhaden began dying in May and it was predicted that millions might perish until the die-off ebbed in late June. The high mortality of menhaden—a figure comparable to losses in previous years—is related to the super abundance of the species in the Chesapeake Bay during the last several years, according to Administration officials, but not to the appearance of the highly visible yellowish tree pollen which accumulates on the water at about the same time. Other species of fish also die in much smaller numbers, but their deaths are attributed to "the environmental stresses placed on all fish during the spring," the Administration said . . . .

. . . . **A California striped bass has set a new record** for carrying a Department of Fish and Game tag. A 30-pound striper caught 5 December 1976 in the Sacramento River near Garcia Bend by Michael Viduya of North Highlands, carried its tag for 18 years, 7 months. The fish had been tagged in Broad Slough during May 1958. Since the fish was tagged as a 25-inch, 7½-pound 5-year-old, its age was estimated at 23 years when caught. Meanwhile, another striper caught in Newport Bay during November by Kevin Leong of Fountain Valley, claimed the record for farthest southward movement of a striper tagged in the estuary. The male bass was tagged 2 April 1974 near Schad Landing on the Sacramento River as a 4-year-old measuring 17½ inches long. It was the first evidence of an estuary-tagged bass moving south of Monterey . . . .

The National Marine Fisheries Service (NMFS) does not approve, recommend or endorse any proprietary product or proprietary material mentioned in this publication. No reference shall be made to NMFS, or to this publication furnished by NMFS, in any advertising or sales promotion which would indicate or imply that NMFS approves, recommends or endorses any proprietary product or proprietary material mentioned herein, or which has as its purpose an intent to cause directly or indirectly the advertised product to be used or purchased because of this NMFS publication.

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